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Contents.

	PAGE
Foundry Prejudice	373
Correspondence	374
Cast-Iron or Steel Water Pipes	374
Deaths	374
The "Hestia" Core Stove	375
Notes from the Branches	375
High Tenacity Brasses	376
American Foundrymen's Association	376
A Visit to the Works of Messrs. Fraser & Chalmers	377
A German Steel-Maker on the Situation	382
Estimation of Minute Percentages of Iron in Foundry Materials	383
Contracts Open	383
Reverberatory Furnace for Non-Ferrous Metals	384
Some Notes on the Production of Sound Castings	385
Dolomite for Refractories	385
Institution of British Foundrymen	386
Iron in Copper and its Alloys	388
Book Reviews	388
An Apprenticeship Course in Foundry Practice.—XVII.	389
Inventions	392
Trade Talk	393
Company News	393
Gazette	393
Iron and Steel Markets	394

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION

Institution of British Foundrymen.

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Foundry Prejudice.

For the purpose of this article we take prejudice to mean an opinion or decision of the mind formed beforehand and more or less unwarranted or unreasonable.

From whatever angle foundry work is viewed, prejudice looms large. Primarily, it is commonly supposed that there is a general prejudice by the engineering industry at large against entering the foundry because of the very bad conditions which are still found here and there. However, it is not this external phase with which we propose to deal, but rather an internal aspect which operates against innovations.

It may sound curious to many of our readers, but there exists here and there militant prejudice against the Institution of British Foundrymen, which, being a prejudice, has no sound base, but, according to one foreman moulder whom we recently interviewed, his objection was that it cultivated, *without protest*, the general principles of metallurgy, and this *after three or four decades of liberal education*. Such an attitude is difficult to comprehend, and enlightened foundrymen would do well to ascertain to what extent this attitude exists. We suggest that it is useless for a member who is known to be an enthusiastic supporter to do any direct questioning, as he would receive nothing definite from prejudiced persons, but rather to question a less enthusiastic member about his foundry associates. The enthusiast would be accused of being prejudiced. As the Institution has less than one representative from each iron foundry, it is interesting to ask why. We can only assume that there are two answers; one is the impossibility of a local branch, and the other prejudice. Perhaps, as we have previously suggested, the holding of two annual meetings, as do *all* similar societies, would do much to remove the first cause.

A second phase of foundry prejudice is against innovations. If exhibited by the managers or foremen, we are of opinion that the provision of adequate experimental funds, so that the new material or machine cannot operate against departmental profits, would dissipate prejudice. The previously-mentioned foreman put forward as his studied opinion that he would not give foundry floor space for a certain type of moulding machine. This is a standard machine of international reputation, which, to our own personal knowledge, is doing excellent work in a large number of foundries.

There exists amongst some foundrymen a prejudice, both personal and professional, against the foundry analyst or metallurgist. If prejudice is made personal, it is usually heard of through a third person. This, too, can usually be dissipated by insisting, wherever possible, on an immediate triangular conference between the originator of the prejudice, the gossip-monger, and the injured person. Such a conference, though unpleasant at the opening, will do more to bring about close co-operation than any nursing of grievances preparatory to different action.

Whilst, psychologically, remedies can be found in some cases to overcome prejudice, it would be interesting to appreciate its origin. We imagine it to have its birth in the non-realisation that there are many types of brains, using the word in its "right of common usage" sense. In the foundry, prejudice has arisen occasionally because a practical foundryman imagines that, because the metallurgist does not immediately grasp the moulder's idea of the best method of making a job, that he is devoid of common sense, and the chemist receives similar ideas when the moulder fails to appreciate the influence of the simple elements on cast-iron. It thus becomes apparent that it is this inability to appreciate each other's brains and outlook that causes prejudice. If the two could only co-operate for a time sufficiently long to assimilate mutually each other's life-work, they would each receive the necessary insight into the other's craft, that would make them realise their true inter-dependence.

The foundry trade undoubtedly is very much tainted throughout by silly prejudices, and any effort that can be made to drive them away should be welcomed. A general survey emphasises that "what is one man's meat is another man's poison," and an effort should be made by people having prejudices to procure for themselves an antidote so that, whatever meat is available, they can easily digest it.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Capital Required for New Steel Foundry.

To the Editor of The Foundry Trade Journal.

Sir,—Would any reader give me a rough estimate as to the capital required to start up a steel foundry capable of turning out 10 tons of castings per week, the weight of castings being from a few pounds to 6 cwts., together with the approximate space required for both foundry and dressing shop?—Yours, etc.,

S. J. B.

Steel Foundry Facing Sand.

To the Editor of The Foundry Trade Journal.

Sir,—Would any reader please advise me as to the best methods of grinding a steel foundry facing sand? The sand in use consists of 20 per cent. siliceous clay and 80 per cent. silica sand. The clay in question, when received, contains a great amount of moisture, thus making it very plastic; also the silica sand is received in a very wet condition. The sand-grinding mill the writer is using is a revolving pan type, fitted with two flat rollers. The writer has in mind that the mill in question is not of a suitable type, and it would be more satisfactory if a mill was used that acted more in the way of a mixer, as the clay is not distributed equally with the silica sand, but is rolled into cakes and the grain of the silica sand crushed. Any information that will help the writer to overcome difficulties mentioned will be very much appreciated.—Yours, etc.,

Steel Foundryman.

Locomotive Cylinders.

To the Editor of The Foundry Trade Journal.

Sir,—I have read with much interest Mr. A. F. Gibbs' Paper on "Locomotive Cylinders," and hope we shall have more practical Papers like this which show plainly how castings are produced in the different foundries and of use to the practical foundryman.

There are a few points on which I should like the author to give some further information.

From the analysis given of the iron used, it would seem to be of too open a character for use in such heavy cylinders as those dealt with, and not likely to give any good results under water test, which is an important feature in this class of casting. From experience, the silicon would be better if from 1.0 to 1.4 per cent., with a higher manganese and lower phosphorus content, to be satisfactory. There may be some method in casting that makes the castings give such good results which the author does not give.

Another feature is the weight given for the charge used in a cupola of five tons per hour melting capacity. Does not 8 cwt. seem small? Should not this be nearer 20 cwt., to be economical and efficient? Also how are the four Roots blowers used for melting; this seems a new departure?

The methods of moulding are no doubt expensive, but this seems to be amply repaid by the results shown in the extremely low percentage of waster castings. This would seem that they must have also a sane method of inspection at the G.E.R., which does not scrap castings for trivial defects. The drawing office can put ½ in. dia. holes anywhere in the barrel of a cylinder for lubrication, but the foundry must not produce castings with only one ½ in. dia. hole to scrap them in some shops.—Yours, etc.,

Foundryman.

October 29, 1922.

Gothenburg Exhibition.—An Exhibition, celebrating the 300th anniversary of the city, which is the chief seaport of Sweden, will be held from May 8 to September 30, 1923, at Gothenburg. There will be exhibits from every branch of Swedish industry, and especially those industries for which Sweden has established a reputation.

Cast-Iron or Steel Water Pipes.

Newport Corporation are considering the question of the pipe line in the Talybont water scheme. Messrs. D. M. Hill & Sons, their engineers, strongly urge the use of cast-iron pipes, as the life of a steel pipe buried in the ground and conveying water is subject to corrosion both externally and internally. Experienced engineers would not use steel pipes if the conditions are such as to permit the laying of cast iron. When they turned from steel pipes to iron pipes they passed from doubtful speculation to proved experience.

In Manchester there were several mains up to 40 in. in diameter which were laid in the year 1850, and were as enduring to-day as then. There were mains in London which were laid in 1811, and examined in 1915, and were found to be both internally and externally as good as the day they were laid. In fact, no limit could be said to the life of a cast-iron pipe.

A proposal will be made to the Council that the contract for laying the cast-iron pipes for the scheme be placed with Messrs. Cochrane & Company, Limited, of Middlesbrough, at a price of £101,906 11s. 2d., and that the proposal to sub-let a part of the contract for cast-iron pipes to Messrs. Jordans, Limited, and Messrs. Thomas Spittle, Limited, Newport, be revoked.

The members of the Corporation visited the Mannesmann Tube Works, and saw the 54-in. steel pipe of the Manchester Waterworks being made.

A letter was read from Mr. T. Trevor Williams, engineer to the Swansea Council, stating that steel tubes were far less liable to corrosion than cast iron. He strongly recommended steel tubes for water mains.

Deaths.

Mr. P. Ellison, formerly an ironfounder at Silsden, Yorks, has died at the age of 66 years.

Signor Ernesto Stassano, the Italian inventor of the steel-making electric furnace known by his name, died recently.

Mr. W. Campbell, Hebburn-on-Tyne, Inspector of Forgings in the Newcastle District for Lloyd's Register, died last week aged 65 years.

Mr. O. Bagshaw, director of William Green & Company, stove manufacturers, of Ecclesfield, and manager of a branch of that firm at West Bar, Sheffield, died recently.

Mr. H. Denton, of The Poplars, Oakland Road, Hillsborough, died last week. He was well known in the steel trade, being partner in the firm of Denton & Best, Birley Meadow Steelworks, Owlerton, Sheffield.

Sir Prince Smith, Bart., of Prince Smith & Son, textile engineers, Keighley, died at Driffield on October 20, in his 82nd year. The deceased Baronet is succeeded in the title by his son, Mr. (now Sir) Prince Prince-Smith, of Whinburn, Keighley, who has been closely associated with his father in the business for many years.

Mr. W. H. Scott, of Moorside, Fenham, one of the principals of the firm of Scott & Turner, Limited, Gallowgate, Newcastle, died suddenly last week. In addition, he held the position of chairman of the Tyne Metal Company, Limited, and was a director of Raine & Company, Limited, iron and steel manufacturers. Mr. Scott was in his 63rd year.

Mr. W. Benson, a founder of the firm of Adams & Benson, Limited, iron and steel merchants, of West Bromwich, died on October 20, at 71, Exeter Road, Exmouth, in his 73rd year. The deceased gentleman, who has been connected with many Midland iron and steel firms, latterly established himself in a smaller business as an iron merchant at Exmouth.

Terni Steel Works.—This Italian concern is to amalgamate with the Società Italiana per il Carburo di Calcio. An exchange of shares is to take place at the rate of four Terni shares for three Carburos.

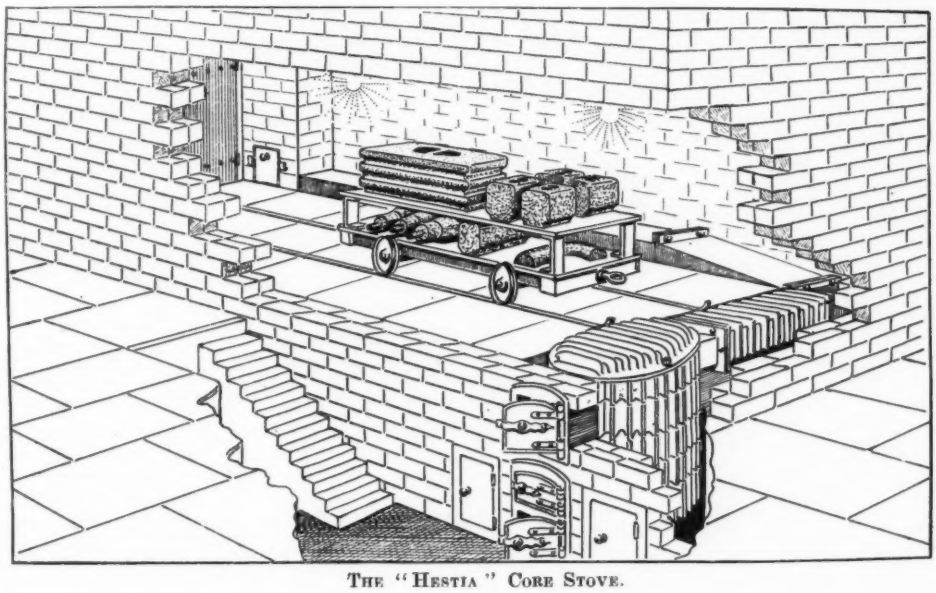
Mr. J. Cook, for fifty years machine shop superintendent to John I. Thornycroft & Company, Limited, has been the recipient of a presentation from Sir John Thornycroft, at the Woolston Works, on the occasion of his retirement. Mr. Cook will retain his connection with the firm in a consultative capacity. He has been a member of the London Association of Foremen Engineers since 1888, and was president in 1895.

The "Hestia" Core Stove.

By J. M. LOCKHART.

Genuine and successful attempts to improve the atmospheric conditions prevailing in most foundries are so rare that an account of a new core and mould-drying stove which has been constructed and provisionally protected by Messrs. John Grundy, Limited, the well-known heating and ventilating engineers, of Tyldesley and London, will be of interest to all foundrymen.

The immediate object of the designers was to make the interior of the core stove fit for human beings to enter, and at the same time to do away with the large volumes of black, sulphurous, smoke and soot which pour into the foundry each time the stove doors are opened. They have not only succeeded in doing this, but have obtained an efficiency in action and an economy in both fuel and labour far beyond their expectations.



THE "HESTIA" CORE STOVE.

The stove experimented with was of the ordinary type, with a large open coke fire at one end, and was 32 ft. long × 10 ft. wide × 7 ft. high, with accommodation for two large core wagons. In place of the open-fire Messrs. Grundy have substituted one of their special slow-combustion air-heating furnaces, in which a large volume of air is passed, entirely without the aid of fan or motor, over the gilled surfaces of the firebox, and does not come into contact in any way with the products of combustion, the air thus retaining all its original oxygen, and therefore its drying qualities. This large quantity of air is circulated throughout the core stove at a temperature of about 205 deg. C. (400 deg. Fah.), and very quickly and thoroughly extracts the moisture from the cores, moulds, etc., and, as the temperature is the same in all parts, it does not in any way distort, crack, or swell the cores.

By this method the cores are uniformly dried throughout their bulk, not simply skin-dried or burnt on the surface only, as is so often the case in cores baked in open fire stoves, and as a consequence they give out a minimum of gas during the process of casting.

The furnace has been placed towards the back end of the stove and below the level of the floor, leaving the whole of the interior available for drying purposes. This position has also the advantage of making stoking into a very easy operation, the coke being simply shovelled down a chute placed on a level with the ground close to the outside wall of the stove. The fumes from the burning coke in the firebox are carried along flues running at the bottom of the inside of the stove, from which a considerable amount of supplementary heat is passed into the chamber, and out to the air by way of a chimney, which also takes away the moisture-laden air from the lower part of the stove through a damper, which can be adjusted as required.

There is thus an entire absence of smoke and soot inside the stove, the cores coming out quite clean and free from dust; in fact, the walls are cleanly whitewashed and electric light is installed. When once the fire is well alight the whole charge of coke for 24 hours' working is put on, and little or no further attention is required. In an actual test, starting from cold, only 5 cwt. of coke was consumed in 24 hours' full working, the amount of ash remaining at the end of that time being 51 lbs.

For many years Messrs. John Grundy, Limited, have been making large grinder-body castings up to 34 ft. in length and 16 tons in weight, in which a dozen or more long cores touch end to end. Since installing the new core oven they have only made one of these, and in this case the cores went into their places entirely without rubbing. This has never occurred before, and they attribute the absence of swelling solely to the new method of core drying. The cores also gave off considerably less gas during casting, thus showing that the drying had been efficiently done.

It is interesting to note that almost any large core stove can easily be converted to this system.

Notes from the Branches.

London.

An extra lecture has been arranged for December 7, when Mr. J. Longden, of Messrs. Tullis & Company, of Glasgow, will present a Paper on "Some Casting Problems of Acid-Resisting Irons." The Branch-President, Mr. Wesley Lambert, left yesterday on a business trip to the States. He hopes to be back in time for Mr. Longden's Paper.

Foundry Queries.

High-Pressure Sand Blasting.

Question: Could you give me any information concerning high-pressure sand-blasting, working with pressure of 80 to 100 lbs. per sq. in., particularly with reference to the size of nozzle, the nature of the hose and the abrasive material used, and similar useful information? Are there any such high-pressure plants successfully working in the British Isles?—H. L. S.

Answer.—The question was fully dealt with in a Paper read before the London Branch of the Institution of British Foundrymen by Mr. E. L. Samson. It appeared in the February 16 and 23, 1922, issues of the JOURNAL.—V. C. F.

High-Tenacity Brasses.

Mr. Smalley Replies to Dr. Johnson.

In reply to the points raised by Dr. Johnson in his criticism of my Paper, published in your issue of the 28th ult., I will endeavour to treat these seriatim.

Work of Other Investigators.

May I point out that after completion of my Paper, it was suggested that the Papers for the meeting should not exceed 12 pages. This necessitated reducing my Paper at the last moment to a bare outline of the original, and made it impossible to include comparison data, detailed scientific discussion and to include the development of the more complex series alloys. In fact, on looking over comparison criticisms with the work of other authors and with the mechanical properties of the well-known proprietary brands of high-tenacity brasses, I find this section alone fulfills requirements so far as the permitted dimension of the Paper is concerned. The foundrymen's thanks, however, are due to Guillet, Charpy, Hoyt, Turner, Hudson, Millington, Carpenter and Dr. Johnson himself, whose contributions have done much in bringing this subject to its present state of scientific understanding; and whilst I have not made use of any test results of these investigators in my report, it is only because of publication restrictions.

Direct Application Sought.

In reply to the question raised relative to the mechanical properties and true equilibrium conditions, may I point out that my intention was not to express theoretical equilibrium but practical tests which might have direct application in the workshop.

A Question of Procedure.

In restoring the rolled slabs to the Brinell hardness of the original ingots, the procedure was to anneal small sections at various temperatures to determine the temperature with constant time necessary to reproduce the hardness of the original ingot. This was undertaken because of the reasons pointed out by Dr. Johnson. Each test was made in duplicate at different times.

Zinc Equivalents.

The figures quoted are, as Dr. Johnson points out, fictitious Zn equivalents, and the total value of zinc thus obtained must be recalculated with the actual copper content to give 100 per cent.

Aluminium in High Manganese Alloys.

With reference to overcoming the ready oxidation of the outside skin of high manganese alloys by the aid of small quantities of aluminium, I cannot altogether agree with Dr. Johnson on this point. Small quantities of aluminium are beneficial, and do improve the skin, but it does not altogether eliminate the trouble, and the precautions outlined in the Paper must be observed.

Grain Size Reduction.

This is a problem full of complexities. The theory I offer for the grain-refining effect of small quantities of iron in brass certainly explains observed facts. We do not understand the nature of solution of metals sufficiently well to be dogmatic on the point. It is certain, however, that under 0.30 per cent. iron, when little or none of the iron-rich particles are discernible under the microscope, the grain is reduced but slightly, whilst above 0.30 per cent. when the particles increase in dimension and become visible under the microscope, the grain size is rapidly reduced and appears to reach a limit at approximately 1.0 per cent. of iron. Exceeding 1.0 per cent., the particles tend to aggregate and also to segregate, but the grain size suffers no further change.

The theory offered assumes that iron is insoluble in brass, and that although the iron-rich particles may not be visible under the microscope in brasses containing under 0.30 per cent. of iron, they are merely colloidally or mechanically dissolved. A simple analogy is the suspension of finely-divided particles of graphite in oil or water. The problem of course is much more complicated than this; and as Dr. Johnson states, "the colloidal dispersion theory is not applied easily to metals which appear to go completely into solid solution such as manganese and nickel, and yet which exert a marked reduction on the grain size."

Manganese Compound.

The evidence I offer of the presence of the manganese compound referred to by Dr. Johnson is metallographic. This compound takes a well-defined crystalline form, and is only found in those alloys containing appreciable quantities of both aluminium and manganese.

I can offer Dr. Johnson no quantitative information on the effect of either sulphur or nitrogen on brass. There is no question that under certain conditions, manganese is an effective de-sulphuriser and of value in the recovery of swarf.

Heat Treatment.

The dimensions of the test-pieces used for the tests quoted were 7 in. long 1 in. by 1 in. The comments made on mass effect are the conclusions of a somewhat exhaustive investigation on these alloys in sections ranging from ½ in. sq. to 4 in. sq., quenching one series in oil at 70 deg. Fah. and another in water at 60 deg. Fah. This investigation is somewhat outside the sphere of the foundryman, and will be dealt with elsewhere at a future date.

American Foundrymen's Association.

At a meeting of the board of directors of the American Foundrymen's Association, held in Chicago on October 3, the retiring President, Mr. W. R. Bean, was elected to honorary membership.

The President, Mr. C. R. Messinger, was in the chair, and twelve directors were present.

The board completed its organisation by electing Mr. C. E. Hoyt, Secretary-Treasurer, Mr. R. E. Kennedy, Assistant Secretary, and Messrs. R. A. Bull, S. T. Johnston, L. W. Olson and Fred Erb, who, together with the President, Vice-President and Secretary, will constitute the Executive Committee of the board of directors for the coming year. Mr. C. E. Hoyt was elected manager of the Department of Exhibits.

The directors provided for a permanent Board of Awards, consisting of the seven last living past-Presidents of the American Foundrymen's Association, Inc., with the junior past-President as chairman of the board.

French Invitation Accepted.

An invitation was received from the Association Technique de Fonderie of France, inviting the A.F.A. to join with the foundrymen's associations of France, England and Belgium in an International Convention and Exhibition in Paris the first fortnight in September, 1923. The invitation was accepted and referred to a committee to be appointed by the President, who will represent the A.F.A. and determine to what extent the Association will take active part in the proposed International Convention.

The Committee on International Relations, to whom the Invitation from the French Association for a joint convention was referred, has been appointed by President Messinger, and is as follows:—Messrs. H. Cole Estep (Chairman), S. Griswold Flagg (Vice-Chairman), L. L. Anthes (Toronto), G. H. Clamer, A. O. Backert, and Franklin G. Smith.

Mr. S. Griswold Flagg, of Messrs. Stanley G. Flagg & Company, Philadelphia, Pa., was elected a director to fill the vacancy caused by the death of J. P. Pero. This Mr. Flagg is the son of Mr. Stanley Flagg, junior, who last summer visited England as a delegate from the A.F.A.

Next American Convention.

A report was submitted to the board of directors, recommending that the next Convention be held in the City of Cleveland, and by mail ballot Cleveland was selected, with April 28 as opening day for the exhibits, and April 30 as opening day for the annual Convention, both Convention and exhibits closing on May 3.

A Visit to the Works of Messrs. Fraser & Chalmers.

The invitation of the Directors of Messrs. Fraser and Chalmers, to the London Section of the Institution of British Foundrymen, to visit their works at Erith, Kent, on October 7 was well responded to, there being some fifty members present. The works were not in operation, but the foundry and the whole of the shops were thrown open to the inspection of the members.

The members of the Branch were conducted through the works by Mr. F. W. Lewis (Works Manager), Mr. Whiting, Mr. A. R. Bartlett, and other members of the staff.

It will be recollected that Fraser and Chalmers were taken over by the G.E.C. Limited, in the early part of 1918, and now operate under the title of Fraser and Chalmers Engineering Works (Proprietors, G.E.C. Limited), becoming the mechanical manufacturing works of this large organisation.

The works were originally established in 1890

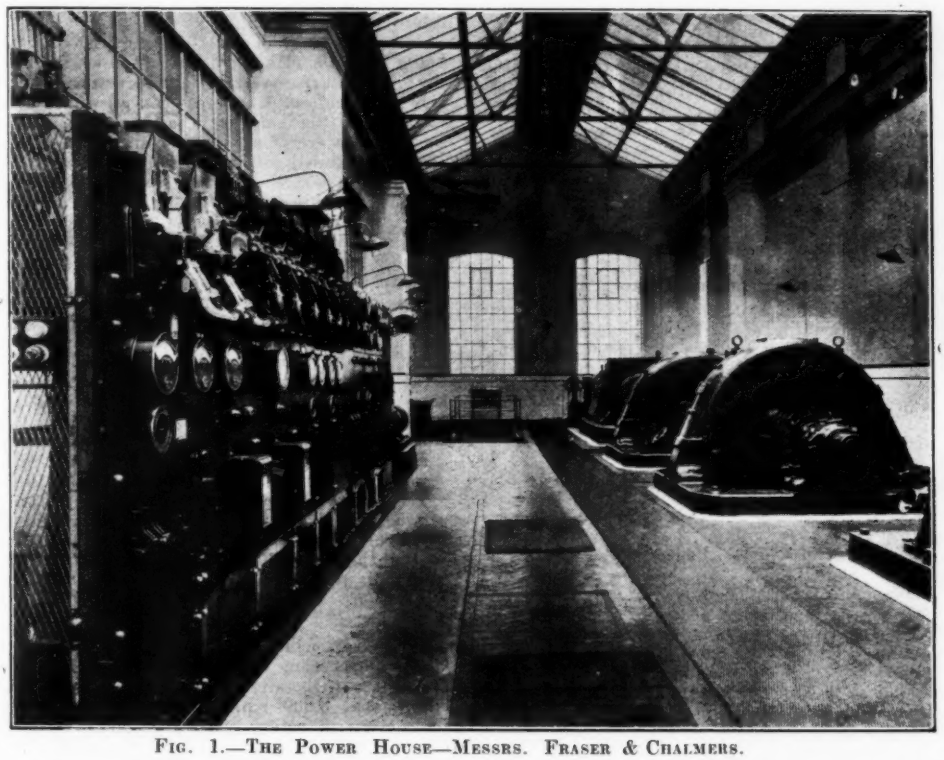


Fig. 1.—The Power House—Messrs. Fraser & Chalmers.

Fig. 2.—General View of the Foundry—Messrs. Fraser & Chalmers.

for the manufacture particularly of mining machinery for which they established themselves throughout the whole of the important mining fields of the world. Extensions of their activities rapidly developed, and they were the first British firm to take up the manufacture of impulse Rateau-type steam turbines in Great Britain, and to develop the important subject of pulverised fuel firing.

The products in these works include steam turbines, turbo-blowers and turbo-compressors; pulverised-fuel-fired "Bettington" boilers and pulverising equipment for the firing of other types of boilers and metallurgical furnaces. Material handling plants, embracing conveying, loading, unloading and storage plants for ores, coal, coke, ashes and grain, etc. Mining equipment for metalliferous mines and metallurgical works, including steam and electric winding engines; concentration, smelting and melting plants; gas-cleaning plant for the purification of blast furnace gases and complete rolling mills equipment.

General Machine Shops.

These are devoted to a great variety of mining machinery, including stamp mills, hardinge mills and the various other crushing mediums; concentration plant; steel and copper converters; blast furnaces and in particular large steam and electric winding engines. An interesting specimen of work noticed was a type of rotary kiln constructed of mild steel plates electrically-welded, which was in position for the machining of end plates.

Foundry.

Naturally this section of the works was most interesting to the visitors, being one of the most up-to-date and largest foundries in the South. The output covers iron casting ranging from the smallest of fittings, machine moulding as many as 40 castings in a moulding box, to castings up to 35-tons weight of the most difficult and intricate character. Special interest was centred in the casing of steam-turbine diaphragms where the nickel-steel blading is cast in special cast-iron and the various analyses of irons used in making up the foundry mixtures. The shop is divided into various sections for loam moulding, dry sand and green sand, and covers an area of 400 ft. × 450 ft. with two main bays and two side bays, and is situated in the centre of the works from which castings can be distributed to the various machine shops. The two main bays are served by six electrically-driven overhead-travelling cranes, 2 of 35-tons, 3 of 10-tons and 1 of 5-tons capacity. These are supplemented by four 7-ton hydraulic jib cranes and six 2-ton jibs, and a runway from end to end of the shop. Four cupolas are installed, ranging in melting capacity from 12 tons to 5 tons per hour, served by a Roots blower through a 20-in. pipe, with pressure registers both at the blast main and cupola in operation. There are 36 moulding machines of various types, the largest running a load of 7 tons to the smaller hand-power machines. Four large drying ovens are installed measuring 20 ft. × 16 ft. × 28 ft., equipped with wagons for carrying loads of from 60 to 80 tons. One large stove is installed exclusively for oil-sand cores, and four smaller stoves for the smaller cores, with draw traps of the latest design, all the core wagons being pulled into and withdrawn from the stoves by mechanical means.

The whole of the power-machines are served by compressed-air service, which is laid throughout the shop and used in various auxiliary ways to aid production, such as driving sieves, chippers, hammers and drills, and also operating the moulding machines. Further, a very efficient shot-blast plant is also served by compressed air. The cupolas are served by a lift, conveying scrap and pig iron, with an elevator system for carrying coke to the charging floors, which have weighing platforms installed. Pig-iron, scrap and coke bins are situated in the immediate rear of the cupolas unloaded direct from the railway wagons by means of electric magnets and portable stackers, the metals being stacked separately according to analysis and grading.

Sand-mixing and handling-plant is situated in the centre of one of the side bays, so that equal distribution is given to every section of the foundry, and the new sand is delivered into this section through the side of the building direct from the store.

Turbine Machine Shop.

This shop comprises the complete manufacture, erection and testing of steam turbines up to 30,000 k.w. capacity in a single unit. Turbo-blowers and turbo-compressors for capacities ranging from 5,000 to 50,000 cub. ft. of free air per min. to pressures of 130 lbs. per sq. in. The shop is practically self-contained to produce the finished plant, including all details, heavy machine work being done on either side with the centre bay being laid out for testing and erection. On each side is a gallery which carries all turbine blade work, and the smaller detail parts. Machines seen on the erection pits, and in course of manufacture included turbo-alternator units of 18,750 k.w. and 10,000 k.w., down to small single-stage turbines running at high speed for condenser auxiliary drives. Also smaller size gear-driven D.C. generator sets, and steam turbines for driving through reduction gearing to main shaft lines for industrial works. Sections of a turbo compressor were seen for an output of 10,000 cub. ft. free air per minute at a pressure of 100 lbs. per sq. in., and in this connection it was mentioned that Fraser and Chalmers had recently completed the largest turbo-compressor unit manufactured in this country, having a normal capacity of 30,000 cub. ft. against a pressure of 120 lbs. with continuous overload of 25 per cent. Their largest turbo-alternator manufactured was stated to have a maximum continuous capacity of 23,500 k.w.

The visitors were able to examine in detail the production of steam turbine blading milled from nickel and stainless steel solid bars. Further, in seeing the method of balancing the rotor wheels and their testing and completion after inspection.

Power Plant.

After reviewing the manufacture in various stages, inspection was made of the works power plant of a turbo-alternator of 1,500 k.w. capacity running at 3,000 r.p.m., and operating in conjunction with rotary converters manufactured by the "Witton" engineering works. The steam raising plant comprised a complete installation of a "Bettington" pulverised-coal-fired boiler, utilising inferior class of fuel at the maximum efficiency, and operating at a working pressure of 500 lbs. per sq. in.

In general it was mentioned that the position of the G.E.C. was such that they were able to contract for complete power plant, manufacturing boiler plant, and both the mechanical and electrical sections of the power units. They have at present going through their shops one of the largest rolling mills to be manufactured in this country, being a 34 in. × 48 in. two-high reversing universal plate mill, the total weight of this mill excluding driving gear, being approximately 2,735 tons and overall length when erected 720 ft. by 72 ft. in width. They have also recently contracted a large order for Spain for material handling plant, and the general aspect of the works show that while the engineering industry might be termed as depressive, Fraser and Chalmers were fortunately contracting some large and interesting orders.

An excellent tea was then partaken of, at the invitation of the directors of the Company.

Address of Welcome.

MR. F. W. LEWIS (Works Manager), who presided, expressed the regret of the General Manager at not being able to be present; he had prior appointments which it was imperative that he should keep. The Company, said Mr. Lewis, esteemed the visit of the London Branch of the Institution of British Foundrymen as something of great interest to them, because, as a firm, they attached the very greatest importance to the foundry. Personally, he considered the foundry as the foundation on which the whole structure of the mechanical part of their products rested. Of course, he did not lose sight of the pattern shop. But it was of the utmost importance in the foundry business that there should be, first and foremost, a very close co-operation between the pattern shop and the foundry. He knew the subject of whether the "top dog" should be the pattern maker or the foundryman had been much discussed, but he was

not prepared to express an opinion. At any rate, with mechanical engineering the products of the foundry were the basis upon which the whole of the results rested, and he was convinced that the average foundryman had not yet realised the importance of his business to the extent that, steam practice, then their products were an absolute failure. As a mechanical engineer, and as one having had a little to do with foundry practice, he impressed upon the visitors the necessity of emphasising, not only to the moulders, but also to the rising generation, the apprentices in

FIG. 3.—READY FOR POURING A LARGE TURBINE CASING—MESSRS. FRASER & CHALMERS.

FIG. 4.—THE FINISH OF THE POURING OF A LARGE TURBINE CASTING—MESSRS. FRASER & CHALMERS.

perhaps, the mechanical engineers of this country had done. The mechanical engineers realised that, unless they could get castings of the right kind, of the right quality, and of the right finish, castings that would stand the pressures which the trend of modern practice demanded, and the temperatures which were coming into vogue in their works who were coming along to fill the ranks, the importance of the foundry industry. In that connection he was very pleased indeed to know that amongst the visitors there was a very large percentage of young men, and he hoped that, as the result of Mr. Lambert's Presidency of the Branch, there would be an increase in the

numbers of such in the Institution. He had been very interested in reading the able speech of the Branch President in The Foundry Trade Journal. He had called the attention of the members to the fact that he was not a foundryman in the true sense of the word. He (Mr. Lewis) congratulated the members of the Branch upon having elected Mr. Lambert to the position he occupied. He did so because he believed it was an indication of the taking of a broadened view by foundrymen, that they had realised that, whilst the foundryman had a most important function to fulfil, he must of necessity be somewhat dependent upon the metallurgist. He believed the day was not far distant when there would be closer co-operation than exists at present between the metallurgist and the foundryman, and when that day came—the dawn was already apparent—then engineers would have what they were seeking, namely, an improved product, one which would bear the increasing stresses which engineering materials were being called upon to bear. He suggested that there was room not only for the metallurgist but for research. His firm

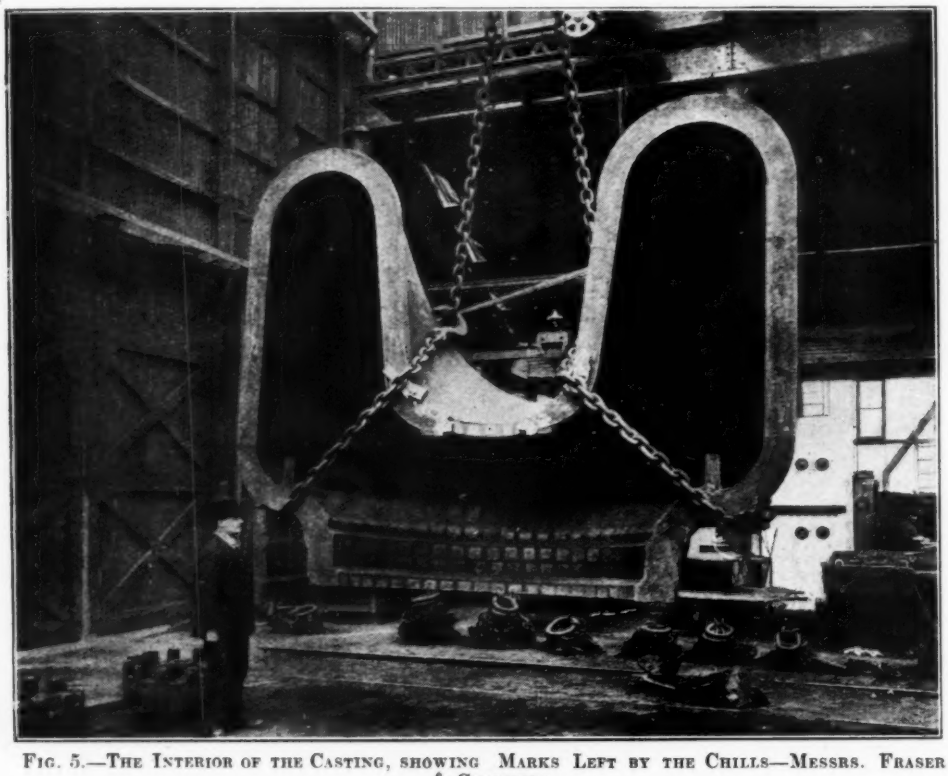


Fig. 5.—The Interior of the Casting, showing Marks Left by the Chills—Messrs. Fraser & Chalmers.

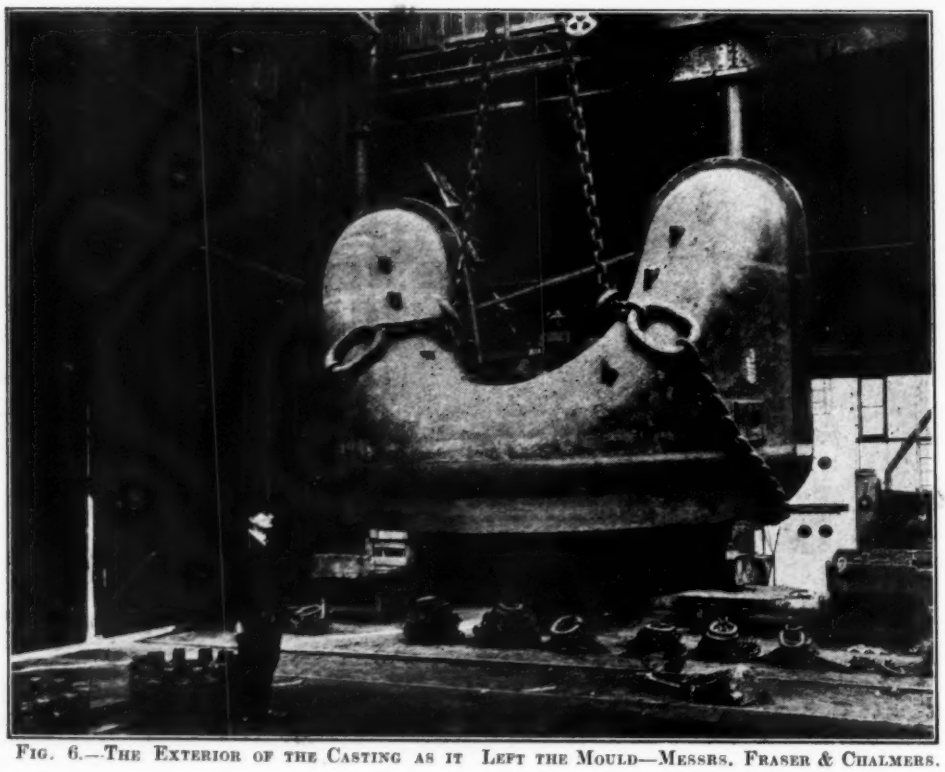


Fig. 6.—The Exterior of the Casting as it Left the Mould—Messrs. Fraser & Chalmers.

recognised that there must be the analytical chemist, and they recognised that they must have their laboratory, but, as a company, they recognised that they must also have a research laboratory outside the ordinary routine laboratory in the works. With this in view, the Company had put up what he believed would be admitted to be, by those who had seen it, one of the finest research laboratories existing in this country, under the able management of Mr. C. E. Patterson, of Wembley. The firm believed that there was a wide field for research. Cast iron was a most important metal, and one which, up to the present, was a necessity; but he looked forward to the day when they would have something better than cast iron which would fulfil for them that which cast iron could not fulfil, and which even cast steel could not fulfil; he believed that when they got it it would be the result of the closest co-ordination between the metallurgists, in the research laboratories, and the foundrymen, in the shops. When these two forces were amalgamated and pulling together, as was necessary, they would get a better product than had ever been turned out before. He suggested that the training of pupils and apprentices, and the bringing of youth into the foundry trades, was a matter which should receive closer consideration than it had received up to the present. He had had the pleasure of going round a great many foundries in this country, and he had been struck by one fact, namely, the comparative absence of young men taking up the foundry business and making it a life study. In the engineering side of the business it was found that in all branches there was a very large number of young men who were as keen as possible to understand their business, to get to understand the elements controlling their business, and to make themselves professional engineers, and he would be delighted to see an increase of that same spirit amongst the rising generation in the foundry. In conclusion, he hoped the firm would have the pleasure of another visit from the Institution in the not far distant future.

FIG. 7.—GENERAL VIEW OF THE TURBINE ERECTING SHOP.—MESSRS. FRASER & CHALMERS.

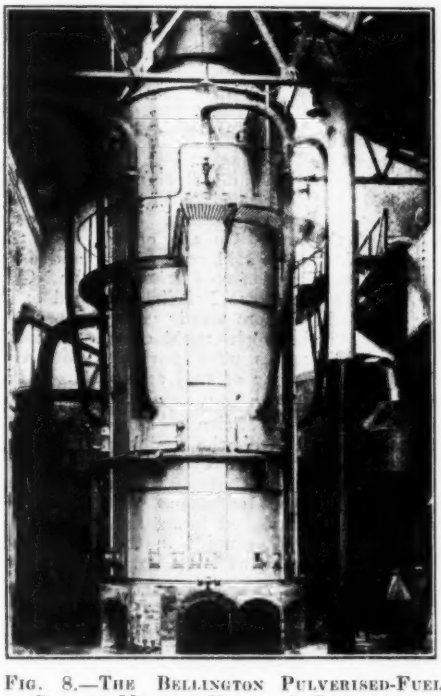


FIG. 8.—THE BELLINGTON PULVERISED-FUEL BOILER—MESSRS. FRASER & CHALMERS.

The Institution and the Industry.

The Branch President, MR. WESLEY LAMBERT, then proposed a very hearty vote of thanks to the directors of Messrs. Fraser & Chalmers, to Mr. Lewis, Mr. Whiting, and Mr. Bartlett, and all those who had contributed towards making the visit of the members of the London Branch so pleasant, so interesting, and so instructive. He was very much indebted to Mr. Lewis for having sacrificed his Saturday afternoon for the members. As for Mr. Bartlett, they all expected him to be present, and had he not been they would have wanted to know why. The remarks which had just been made by Mr. Lewis, by reason of his earnestness, might almost be regarded as a sermon, and he hoped that all the members of the Branch would take those remarks to heart. In a conversation he had had with Mr. Lewis, he had asked him whether he knew of many foundrymen who had put their sons into the foundry, and he had replied that there were not many. He (the

Branch President) knew that too; but why? Was it because they were ashamed of their own trade, or of the conditions under which they worked? If so, he could only say that foundrymen now had it in their hands to improve those conditions, because the Institution of British Foundrymen was a recognised Institution, and in course of time would control the whole industry. The Institution could work towards improving conditions in the foundries, and the members must all recognise, from what they had seen that day, that it was necessary to pay very close attention to foundry problems. He had gathered that Mr. Lewis was proud of the castings made in that foundry. If he were proud of them, it was not because he laid claim to being the founder. He looked to Mr. Whiting, Mr. Bartlett, and their assistants, and therefore, if they had a works manager or a general manager who was proud of the castings made, it reflected to the credit of the foundrymen. The castings he himself had seen that day had struck him as being very excellent, as castings, and the iron was excellent. He again thanked the directors for having permitted the members of the Branch to visit the works. for having shown them the whole of the shops in the way they had done, and for having provided an excellent tea.

MR. J. ELLIS seconded the vote of thanks. He was very pleased indeed, as a foundryman, to hear Mr. Lewis indicate what his firm was doing in the way of research. The need for research was one of the things which the Institution, in its very early days, had started out to instil into the minds of the employers. They all acknowledged, as foundrymen, that on many occasions they did not know what was happening when wasters were in evidence, and because of that they had struggled very hard to get the employers to fit up laboratories for research work. There was very little laboratory work done forty years ago. If anything at all was done in the direction of research, it was done in the foundries by rule-of-thumb methods. When they had a waster they used to break it up, and one man would say there was a blowhole, whilst another would say it was not a blowhole but a draw. But they did not get at the scientific reason for it. In going through the foundry that afternoon, the thing that had struck him most was the beautiful skin on the castings. He had been in many foundries recently, and had found in use a pneumatic chipper chipping off the slag from the castings. Some of them looked as though they had come from a gravel pit. He had never been in a foundry in which he had seen so many good castings and so few defects as he had seen in the foundry of Messrs. Fraser & Chalmers. Following up the remarks of Mr. Lewis with regard to the importance of foundry work, he said he believed that if 100 moulders saw the casing which they had all seen in the foundry that afternoon, and had to make a similar one, 99 of them would not know how to start. It was a most intricate piece of work, requiring great skill and attention, and he believed that in that aspect the foundryman's work was not considered to be so important as it really is. Quite recently he had heard a managing director telling a visitor to the foundry that there was really nothing in foundry work; all that was necessary was to make an impression in the sand and pour the metal in. He asked them to imagine the result of defining foundry work in that manner

The vote of thanks to the directors of the Company, coupled with the names of Mr. Lewis, Mr. Whiting, and Mr. Bartlett, was accorded with enthusiasm.

MR. LEWIS, in a brief reply, said that the manner in which the visitors had responded more than compensated for any little trouble the Company had taken.

AT THE ANNUAL MEETING of the Junior Institution of Engineers (North-Eastern Section), held in the Armstrong College, Newcastle, on October 24 Mr. Brackenbury (president) presented the silver medal for the best paper to Mr. J. Calderwood for his paper on ship propulsion. Mr. Brackenbury, in his address, after giving some results of experiments in the brazing of nickel steel, spoke of the education of the engineer and praised continuation classes.

A German Steel-Maker on the Situation.

HERR PETER KLÖCKNER, in the course of his address to the annual general meeting of the Lothringen Ironworks and Mining Company on October 12, remarked that while the depreciation of the mark in recent months had resulted in an influx of foreign orders, it was now playing havoc with finance. The working capital of concerns was no longer equal to the enormous increases in prices, and it would only be possible for industry to find wages and salaries for a short time longer and keep the works going. In many cases attempts were being made by concerns to help themselves by making the conditions of payment more strict, but this expedient could not be commended. It would find imitators, and if generally carried out would eventually lead to economic collapse. The directors of the Klöckner Group held the view that large and small concerns must hold together in such a crisis of credits and no exceptional terms of payment must be enforced, but efforts must be made to maintain business as long as possible by a system of barter.

During the past year the nation had endeavoured to turn out more work, but the additional output had proved insufficient. The overtime agreement in the Ruhr mining district had only yielded small results, and had at the same time considerably increased the pits' costs of production. In the case of the Company's own miners, about 90 per cent. were working overtime, partly two hours on three days and partly one hour on six days a week. But the extra production was inadequate. It would be necessary so to increase the output as to oust foreign coal and have sufficient coal available to permit the steelworks to expand their output and thus make the importation of foreign steel unnecessary.

The systematic enforcement of the eight-hour day, Herr Klöckner proceeded, was hampering economic life, and prevented appreciable improvement. The applications for increases in wages and salaries, which were now being made not only monthly, but even fortnightly, had not in a single instance been accompanied by a voluntary offer of doing more work. It was no wonder their course was downhill, as all increases in wages immediately advanced the cost of living and further depreciated the mark. The Federal Government had frequently asked the nation to work harder, but had hitherto taken no steps to abolish the eight-hour day. The time would come when hunger would force them to work harder.

At present the German coal and iron industries were fully occupied, and foreign countries were still able to purchase goods, although even neutral countries in Europe suffered from the consequences of the war. On the other hand, their oversea business was still very active, and orders continued to arrive from British India, China and Japan, while Great Britain remained one of their customers. There was in general more work on hand than the works could execute, but most of the establishments were working short time, owing to the scarcity of coal and coke.

As regards foreign markets, the speaker stated that increasing competition was being offered by Belgium and France, the industries of which countries were assisted by export and freight bonuses, whereas the German works were greatly hampered by export embargoes and taxes. The inland demand continued large, and many industrial concerns were occupied in the carrying out of work for renewals and repairs.

THE DECISION of the Admiralty to invite tenders for battleships has caused general satisfaction. Among the firms tendering are Sir W. G. Armstrong, Whitworth & Company, Limited, Palmers Shipbuilding & Iron Company, Limited, and Swan, Hunter & Wigham Richardson, Limited. In addition, Palmers Shipbuilding & Iron Company, Limited, Hawthorn, Leslie & Company, Limited, Wallsend Slipway & Engineering Company, Limited, and Parsons Marine Steam Turbine Company, Limited, will tender for machinery, and Sir W. G. Armstrong, Whitworth & Company, Limited, for armaments.

Estimation of Minute Percentages of Iron in Foundry Materials.

By "Celsian."

To determine minute percentages of iron in materials such as silica bricks, sand, limestone, etc., the sulphocyanide colorimetric method is generally preferred. Among other advantages, this method is claimed to secure accurate results in presence of large quantities of impurities. One of the first analytical books which gave a description of this estimation was Beringer's "Text Book of Assaying."

Further investigations of the most accurate method of applying the determination have since been made, and some of these, as used in works practice, are here given.

Usual Method.

The method consists in first dissolving the material in a suitable acid, or where of an insoluble nature, fusing with a fusion mixture and extracting the melt with water, and acidifying. A solution of permanganate of potash is added until the solution is tinted, after which it is boiled, cooled, and diluted.

Potassium sulphocyanide is then added, and the red coloration produced compared with that of a standard iron solution prepared under similar conditions. The assay solution is diluted until its depth of colour is identical to that of the standard, and the percentage of iron present computed by proportion. This is the description usually given in analytical text books, together with a few details of the effects caused by altering the conditions.

According, however, to the researches of two well-known chemists, the red coloration developed is not necessarily proportionate to the percentage of iron, but is greatest when the sulphocyanide and iron are present in equal proportions. The inaccuracy is due to the fact that the red coloration, formed by a ferri-potassium sulphocyanide which is decomposed by water, cannot serve as a guide to the amount of iron present, since the intensity is a function of the dilution.

A double salt is formed which on dilution is converted to another double salt of iron and potassium sulphocyanides. Solutions of the latter salt are lighter coloured, and are tinged with orange. It has also been proved that solutions of ferric sulphocyanide and coloured solutions of double tartrates and acetates of the alkalies are subject to progressive dissociation of the pigmentary salt, and therefore impossible of comparison with standards in colorimetric estimations. Despite the fact that these inaccuracies are known, the method is still largely adopted, but many precautions are taken that the standard and assay solution are compared under exactly similar conditions.

Best results are secured by using cold solutions, and making the comparison immediately after addition of the potassium sulphocyanide. An excess of free acid tends to increase the depth of colour produced, particularly with nitric acid, as nitrous acid itself is capable of forming a red colour with potassium sulphocyanide. The method is seldom capable of producing quite so accurate results when phosphorous or arsenic are present, as the effect of these requires to be eliminated by addition of an excess of hydrochloric or other acid. Copper is one of the few metals which are capable of interfering with the colour produced, but this metal is seldom found present in materials such as limestone, fireclay, silica bricks, etc. If any copper is present it is readily noticed, as the solution will have a greyish-green tint, which may then be tested with ammonia.

The estimation takes longer to perform when the latter impurity is present. One method consists of precipitating the iron as arsenate, redissolving in dilute hydrochloric acid, and proceeding as before. Very few processes in which the iron has first to be precipitated, before applying the colorimetric assay, will yield satisfactory results.

The following description gives details of a modified method which has furnished the best results up to the present time.

Method Advocated.

After dissolving the material by one of the usual methods, the solution is diluted considerably and made to contain about 5 per cent. of nitric acid. The solution is treated with potassium sulphocyanide, and when the dirty reddish colour develops, about 10 c.c. of ether are added and the liquor thoroughly shaken up.

The tubes used for the test are made of very clear glass, graduated, and provided with emery stoppers.

By shaking up with ether, the sulphocyanide compound of potassium, iron, etc., is decomposed and the iron sulphocyanide dissolved out alone.

The aqueous solution should be completely decolorised if the proper conditions have been adhered to.

As the colour of the ethereal layer deepens on standing, it should be allowed to rest for some time before comparing with the standard iron solution.

The standard iron solution preferred for this work contains about 0.01 gm. of iron per litre, and is made up by dissolving ammonium ferrosulphate in distilled water containing a little sulphuric acid.

All reagents used throughout must be carefully examined for traces of iron, and their combined result subtracted from the amount of iron present in the assay solution.

Contracts Open.

Bagdad, November 30.—The Ministry of Defence, Bagdad, invite tenders for supply of 980 extra large stirrup irons (5-in. tread) and 420 large stirrup irons (4¾-in. tread) of British Army regulation pattern, standard, and quality. The Department of Overseas Trade (Room 49), 35, Old Queen Street, London, S.W.1.

Barnsley, November 6.—Supply of about 60 tons of cast-iron pipes and specials, 8-in. and 3-in. diameter, for the Town Council. The Waterworks Engineer, Doncaster Road, Barnsley.

Dublin, November 13.—Stores, for the Great Northern Railway (Ireland) Company. Mr. J. B. Stephens, secretary, Amiens Street Station, Dublin. (Fee, 1s.).

Johannesburg, January 2.—Supply of tramway points and crossings, for the Municipal Council of Johannesburg. The Department of Overseas Trade (Room 50), 35, Old Queen Street, London, S.W.1.

Leadgate, etc., Durham, November 20.—Supply of approximately 2,825 straight pipes, 9-in. internal diameter, cast vertically in dry sand moulds, for the Durham County Water Board. The Engineer, Bishop Auckland.

London, S.E., November 17-23.—The High Commissioner for India is inviting tenders for supply of (2) cast-iron pipes, socket and spigot, 15 in.; (3) railway wheel turning lathes, 48 in.; (4) d.c. low-tension three-core and two-core cables; (5) flexible steel wire rope, galvanised and ungalvanised; (6) copper tubing; (9) buffers, wrought iron, and washers for buffer springs; (10) axle-boxes, malleable cast iron or cast steel for carriages and wagons. The Director-General, India Store Department, Branch No. 14, Belvedere Road, Lambeth, S.E.1. Tenders by November 17 for Nos. 2 to 4, and November 23 for Nos. 5 to 10.

Manchester, November 14.—Supply of anti-friction white bearing metal, for the Tramways Committee. Mr. H. Mattinson, general manager, Corporation Tramways, 55, Piccadilly, Manchester.

Maldon, November 14.—Supply of about 1,227 yards of 3-in. and 440 yards of 2-in. cast-iron pipes, for the Maldon Rural District Council. Mr. W. Almond, surveyor, 6, Market Hill, Maldon, Essex.

Forges et Aciéries du Nord et de l'Est.—This French concern (share capital, 77,425,000 fcs.) reports for the financial year, 1921-1922, net profits amounting to 630,936 fcs., after certain allocations. There is to be no dividend. This amount, as well as the sum brought forward from last year, 1,355,189 fcs. (say £33,200 in all), are to be carried forward to next year.

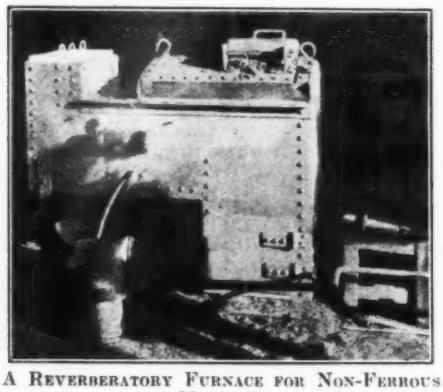
Reverberatory Furnace for Non-Ferrous Metals.

By the courtesy of Messrs. Worthington-Simpson, Ltd., our representative was permitted to inspect the air-blast reverberatory furnace installed in the brass foundry at their Newark Works.

This furnace of one-ton capacity was the first to be built under the patents of British Reverberatory Furnaces, Limited, 82, Victoria Street, London, and as it constituted such a revolutionary departure from all existing methods of melting non-ferrous metals, it was regarded in the light of an experimental installation with which to prove thoroughly the system on commercial lines, and in the light of experience so gained introduce into the design such modifications and refinements as might from time to time be considered advisable. The furnace has, however, now been in operation for approximately 12 months under everyday conditions, during which time it has proved itself an essentially sound and practical proposition, fully justifying the sanguine anticipations of the inventors without the necessity of modifying in any way the essentials of the original design; indeed, the only alteration made in the structure is the position of the firing hole, which has been more conveniently placed at the top instead of, as at first arranged, in the side of the combustion chamber.

General Construction.

The general construction of the furnace will be understood from our illustration, which, however, shows the ½-ton size. The casing of the original furnace was made of cast-iron in order to reduce



A REVERBERATORY FURNACE FOR NON-FERROUS MELTING.

the costs of structural alterations, had such proved necessary; normally the casing will be of steel plate as shown. The working bed of the furnace is provided with a vaulted roof, it is separated from the combustion chamber by a fire bridge, and communicates through a restricted passage with the uptake, which is also the metal feeding hopper. The motor-driven fan is attached to the back of the combustion chamber and delivers the blast at about 6-in. w.g. beneath the fire bars. The fan control is housed, as shown, on the end of the furnace adjacent to the metal hopper. The inspection door provided in the side wall above the tapping hole also fixes the limit of the full charge for the furnace.

Charge Sheets.

The furnace has given remarkable results in operation. We are indebted to British Reverberatory Furnaces, Limited, for the following figures. On October 15 they demonstrated the one-ton furnace at Lowfield Engine Works, to Mr. Spittal and Mr. Whiteman, of Messrs. Allen Everitt, Limited, of Birmingham. The following charge sheet was obtained:—

Gun-metal Charge Sheet.

Pre-heated furnace with 75 lbs. of coke.
1.40. Re-charged furnace with 75 lbs. of coke.
1.43. Charged gun-metal, consisting of hard scrap and copper, 13 cwt. 1 qr. 8 lbs.
1.58. Re-charge, 90 lbs. of coke.
2. 3. Alloy additions made.
2.15. Metal tapped.

Copper Melting Charge Sheet.

2.56. Charged 60 lbs. of coke and 6 cwt. of scrap and copper (98 per cent. copper).
3.09. Bath completely melted, when we began "polling" in about 10 minutes. The visitors took samples from the furnace with a small ladle, which were tested and gave satisfaction.

More Gun-metal Charges.

On October 11 the furnace was demonstrated to Mr. Collyer and Mr. Miller, of Messrs. Adams & Company, Birmingham, and the following result was obtained:—

Pre-heated furnace with 87 lbs. of coke.
2.0. Charged 87 lbs. of coke.
2.2. Blast started.
2.5. Metal charged, consisting of No. 2 gun-metal mixture, containing about 80 per cent. copper, 20 cwt. 0 qr. 18 lbs.
2.22. Re-charged with 116 lbs. of coke.
2.35. Metal gone through the hopper.
2.45. Alloy additions made.
2.50. Metal tapped.

Advantages.

The elimination of crucibles, though important, is by no means the most important advantage of the furnace under consideration. In the first place the economy in the matter of ordinary charging is really considerable. The hopper in this instance will take pieces of metal up to 500 lb. in weight, whilst runners and other scrap metals can be utilised without having to cut them up into small pieces, as would be necessary with the crucible with which the heat would not be sufficient to melt such pieces in a reasonable time, even assuming the crucibles were able to stand the stresses incidental to such practice. The question of losses by volatilisation and oxidation are vital considerations, such losses, when melting yellow brass in the crucible, may easily average from 5 to 7 per cent., whilst losses of from 3 to 4 per cent. may be regarded as a fair covering average for the whole of the usual non-ferrous alloys. Our representative was informed that the loss in the furnace under notice averages only 2 per cent., and as the metals most subject to waste are usually the most expensive ones, economy in this direction is of paramount importance. Volatile losses are further reduced by the fact that it is unnecessary to add zinc and other quickly-wasting constituents until the ingot copper or scrap has reached the fluid stage. The greater heat available in the furnace also renders it unnecessary when casting phosphor bronze to add, as is usually done, an excess of phosphor copper, in order to obtain an alloy sufficiently fluid for casting.

The separation of the fuel from the metal serves to reduce to a negligible minimum loss by oxidation.

Finally, when casting out, the furnace can be tapped like an ordinary cupola, the metal remaining in the well being maintained in perfect condition by a gentle blast, a valuable feature which is, of course, wholly impossible with the crucible furnace.

Demonstration Results.

Our representative had also an opportunity of inspecting the ½-ton and 5-cwts. furnaces. In the first-named a charge of ½ ton of copper was melted and drawn off in 30 minutes, 1 lb. of coke being used per 5 lbs. of metal melted. The five-cwt. furnace is likely to prove the most popular size for the small foundry, as also for the general engineering shop casting their own brasses, etc. This furnace occupies a floor space of only 5 ft. × 2 ft. The furnaces, being entirely self-contained, lend themselves very readily to portability, to which end they can be supplied upon a wheel base, a very convenient arrangement making it possible to pour direct into the moulds and thereby effecting a saving both in time and labour.

Our representative had an opportunity of witnessing a demonstration with the ¼-ton furnace.

The fire was lighted in the furnace at 10.30 a.m., but owing to the foundry not being ready for the metal, blast was not put on to the furnace till

1.45 p.m., up to which time 41 lbs. of coke had been charged into the fire box.

First Melt.—The weight of metal charged was 4 cwt. 3 qr. 15 lbs., and consisted of ingot and scrap copper. The following time-table gives details of the working:—

1.47. Charging commenced.
1.59. Re-charged furnace with 31 lbs. of coke.
2. 6. Finished charging metal.
2.14. Additions made.
2.20. Tapped into ladle.

Second Melt.—The weight of metal charged was 4 cwt. 3 qr. 4 lbs., and consisted of heavy copper scrap:—

2.25. Re-charged furnace with 31 lbs. of coke.
2.28. Commenced to charge metal.
2.42. Re-charged furnace with 31 lbs. of coke.
2.52. Completed charge of metal.
2.58. Additions made.
3. 5. Tapped into ladle.

The time taken in charging the metal in the second melt was due to much of the scrap being of a size above the width of the metal hopper on the furnace, although fairly light in section. It would be more profitable to put such material under the shears before charging.

Some Notes on the Production of Sound Castings.*

By CHRISTIAN KLUYTMANS.

The amount of moisture in the air supplied to a cupola is an important factor in fuel consumption. When foggy weather is prevalent filtration of the air to free it from the watery particles held in suspension will considerably increase the efficiency of a cupola. No open coke fires should be in the neighbourhood of the blower intake, for they produce large quantities of CO_2 which would be drawn in and delivered to the cupolas, so cutting down the supply of oxygen. The volume of air is of the highest importance, and should be considered from the point of view of the amount of oxygen delivered, yet it frequently receives less attention than any other factor.

A French writer considers the factors in the following order: (1) Hourly production; (2) blowing plant; (3)' coke; (4) cupola. Starting with (1), the amount of air necessary to burn the maximum quantity of coke (per unit of air), which will melt the greatest quantity of iron is then based on the three factors—iron, volume of a given time. The dimensions of the cupola are air, and weight of coke.

From the composition of the air it is known that to obtain 1 volume of oxygen there must be 4.347 volumes of air. It is easy, then, to find what weight of coke can be burnt with a blower giving the fixed volume of air. The composition of the coke must be known so that the quantity of oxygen required for the complete combustion of its ingredients can be calculated. A coke of good quality, high in fixed carbon and low in ash, will utilise more oxygen than will a poor coke, low in carbon and high in ash. If the same volume of air is delivered in both cases then there will be an excess of oxygen when the poor coke is used, and consequently oxidation of the iron. The use of an inferior coke necessitates a larger proportion of fuel in the charge. Poor coke, too, being friable, settles into masses in the furnaces and there is danger of the air short-circuiting through the gaps leading to great waste of heat and oxidation of the metal.

Position of Blower.

The best position for the blower is as near as possible to the cupola, and care must be taken to see that the delivery pipes give sufficient air at the cupola with as little loss of pressure and volume as possible. Authorities differ as to the ratio between the area of tuyeres and that of the greatest diameter of the cupola; some say 1/10, others 1/7, and, in England, 1/5; it is always easier to reduce the area of the tuyeres than to increase it. A suitable indicator from which the pressure and volume of air can be determined at a glance is very useful, and it is essential that the blast should always be consistent. To maintain an even zone of heat the air must be delivered equally from all sides, and it would seem that two rows of tuyeres are better than one for this purpose. With two rows it is easier to deal with a charge that is "hanging" in the furnace, because the hottest zone can be raised to re-fuse the frozen part.

Since the blower is delivering a constant volume of air at a constant pressure, the cupola should be burning a corresponding weight of coke which, in turn, should provide the heat units to melt a corresponding tonnage of iron. The output calculated from these factors gives a sound basis for comparison, and if the actual output falls far short of this figure the cause should be traced and removed.

Height of Cupola.

The height of a cupola is generally taken as four times the diameter; in France a minimum of five times is taken. The greater height allows for the burning of the CO and saving of heat. In considering the effective diameter of the cupola it should be noted that increase of diameter means reduction of air pressure, but also means a thinner fuel bed, for which the air pressure may then be too great. For a smaller diameter the opposite is the case. Increase of diameter may result from excessive rate of melting, whilst hangings and "scaffolds" will lead to a reduction of diameter. In either event the blast indicator will at once show the variation and the necessary steps may be taken. The operation of charging the cupola should be based on the quantity of air, which determines the weight of coke that can be burnt. The proposition of iron is then determined from the heat available; any change in this proportion leads to variation of the quantity of air and inefficient working.

Cold Metal.

When the metal taps cold and sluggishly the proportion of iron is probably too high, or, if the proportion is correct, the pieces are too large. In the first case the weight of metal charged must be reduced; obviously the weight of coke cannot be increased without also increasing the amount of air which would lead to further trouble. Excess of coke leads to incomplete combustion and irregularity of melting in the fusion zone. When starting up a cupola it is better to make up the early charges with the pig in small pieces. When large pieces are charged—the furnace must be thoroughly hot—it is better to surround them with smaller pieces, which, melting first, help to bring down the big lumps. This question of charging according to fixed rules is very important, and has a great effect on the final result. In determining the weight of charges, liberal allowance must be made for the heat losses due to radiation, incomplete combustion, etc. Rather more than double the number of heat units theoretically required to melt the iron must be supplied. Naturally, when starting a cupola from the cold the proportion of coke must be increased, and that of the iron diminished until the furnace has become thoroughly hot. The remainder of the Paper is devoted to chemical reactions and microstructure.

* A Paper presented to the Nancy Meeting of the French Foundrymen's Association.

Dolomite for Refractories.

Briquettes containing 90 per cent. dolomite and varying percentages of iron oxide and clay have been burned by the United States Bureau of Mines at the ceramic experiment station, Columbus, Ohio. Slaking-time tests were made, and the results plotted. The slowest slaking mixture was selected for making into bricks which were burned to a sufficiently high temperature to render the lime inactive. Bricks with a high fusion temperature and high specific gravity, great mechanical strength, and low porosity were the result. The work is being continued, using varying percentages of dolomite to determine the non-slaking areas over the entire field.

XUM

Institution of British Foundrymen.

NEWCASTLE BRANCH.

On Saturday, October 21, Mr. H. J. Young (Branch-President) gave a lecture on "The Problem of Grey Iron Castings," which was published in THE FOUNDRY TRADE JOURNAL of December 22 and 29, 1921.

"THE PROBLEM OF GREY IRON CASTINGS."

MR. YOUNG, before commencing his lecture, said the Paper was originally read before the Institute of Marine Engineers, and was, therefore, a Paper for engineers. It was his intention not to actually read the Paper, but to give it in a conversational manner and from the educational point of view.

Discussion.

MR. WISE said that, as one there to be taught, he hoped Mr. Young would bear with him in a few remarks. They were told that what they wanted was scientific control, but Mr. Young did not mention whether it meant scientific control chemically or physically. The reason he mentioned this was because for some years he had been responsible for the output of a certain class of work which was turned out under scientific control, and, although their chemical analyses were fairly constant, nevertheless, physically, they had great fluctuations after, and sometimes before, they left the foundry. That chemical analyses only will control results had not been his experience, but, at the same time, he did not want to give the impression that he was not in favour of chemical analyses.

He also mentioned the graphitic plates, and asked whether Mr. Young held the opinion that carbon influenced the growth of cast iron, because he himself was of that opinion. Once, when they were having trouble with growth in pistons, they had test-bars taken and measured and reheated, and they found that if they decreased the phosphorus they ran greater risk of growth. He then thanked Mr. Young for his excellent Paper, and said that the more educational Papers of this kind that were given, the better it would be for foundry trade in general.

MR. LILLEY said that he had listened with great interest to Mr. Young's Paper, and that he was a firm believer in scientific control. He would like to know if Mr. Young could tell him how to control 200 tons of pig-iron; whether each pig is analysed separately.

Changed Foundry Conditions.

MR. PAULIN said that he was very grateful for the plain way in which Mr. Young had made clear the effects of the different metalloids on the casting. He spoke of the effects of the increase of sulphur above the proper amount, and said that, as long as an increase in the manganese content took place, the sulphur was not really harmful. Did Mr. Young confine that statement to such a casting as a liner, or did the same thing apply to a wheel? He appreciated Mr. Wise's criticism, as it dealt with the ideas which are in many people's minds as to the value of chemical work in the foundry, but at the same time he thought that the time was past when one need question as to the value of the chemist in the foundry. In the past people have been working in the dark, the good results which were obtained in the olden days being possibly due to the fact that the pig-iron was purer than it is to-day. There is no doubt that if the foundryman who made good castings in those days was given the material we have to use to-day, he would not have been so successful. The people who have in the past done without the chemist should not necessarily still believe that they can do without him.

He would be very much interested to know if the experience Mr. Young obtained regarding the test-bar taken from the liner casting, and which proved to be almost the same as the actual test, cast with the casting, as regards physical tests, could be expected to be repeated with any casting, as it had always been, as far as he knew, accepted that if a test-bar was taken from a thick portion of a casting it could not be expected to give the same physical results as the test-bar cast in the ordinary way.

MR. LOGAN stated that his experience regarding pig-iron variations was similar to that of Mr. Young, and gave analyses of one of the pig-irons mentioned in the tables where the silicon had varied 1½ per cent. in different consignments over the last two and a-half years. He considered that the sulphur-manganese balance should be more widely known and very fully investigated, as, although himself a believer in its application, he had come across apparent exceptions for unknown reasons. He gave one instance where two irons, made from the same mixture and with the same pig-irons, gave very good bars, and, later, very bad bars—the only differences in composition being that of sulphur and manganese. The good bars contained 0.160 per cent. sulphur and 0.33 per cent. manganese, whilst the bad bars contained 0.132 per cent. sulphur and 0.54 per cent. manganese, from which one would expect the good bars to be the bad ones, and vice versa.

MR. MATTHEWS did not agree with Mr. Young in his statement that very little reliable work has been done upon the cupola, because he thought a considerable literature had grown up around the subject. In this connection Mr. F. J. Cook's Paper before the 1913 London Conference should be noted.

The Author's Reply.

The PRESIDENT, in answer to the discussion, said that Mr. Wise had seemed to intimate that he had suggested that chemical analyses were all that were necessary to get good iron, but he would like to point out that there are people called analysts in this country and people called chemists, and the average analyst is not a chemist; he has yet to become one. Analyses are made in order to learn accuracy. There are a great many works which analyse their iron and get very little good out of it, because they do not know what to do with the results. There are ten or twenty elements or compounds for which we do not analyse; therefore, he did not think that analysis as we know it will control iron. Everything must be estimated before one can safely use the expression "cannot be controlled by analysis."

Mr. Wise had brought up the question of the sulphur globules in the iron. He (Mr. Young) was afraid that he had been too free in speech, as the globules consist of iron and manganese-sulphide—practically a slag—and float about and very often come to the top. By adding ferro-manganese to iron, the sulphur is sometimes partially removed and comes out as slag, which is far less harmful than unbalanced, and which explains how, with sufficient manganese, one can keep the sulphur under control.

Growth of Cast Iron.

With reference to the question of growth, the carbon and the carbides determine the strength and properties of the iron, but, on the other hand, the silicon, sulphur, phosphorus, and manganese, etc., control the carbon and carbides. The plates of graphite shown on the screen are really minute spaces filled up with carbon. During the process called "growth" they expand and contract, and reactions take place which cause the iron to swell, but the composition of the iron would determine how much that swelling takes place.

In reply to Mr. Lilley, Mr. Young said that if one buys a number of different brands of pig-iron, analyses and mixes them thoroughly, and puts into the mixture three or four or more pig-irons, a very good average would be obtained. He advised Mr. Lilley, when he was making special castings, to procure some pig-iron that does not vary so much, for, as long as the iron is mixed properly and scientifically, it is all right.

Regarding Mr. Paulin's question as to whether the mixture used for a liner is suitable for a wheel casting, he thought that high and balanced sulphur could be used for a liner, but not for a wheel. If one gets sufficient manganese, the sulphur can be controlled, but it was safer for average foundrymen not to try high sulphur without the help of a chemist.

Mr. Logan said that he had had cases of finding better metal with low manganese-content than

with high manganese-content. That may be so. It does not follow that, because one has got the proper amount of constituents in their iron, that good results will be obtained. If the manganese-content is good, so ought the metal to be, but there might be other reasons for its failure, such as temperature, cupola practice, etc., or there may be an element not analysed for that may account for it.

In reply to Mr. Matthews, Mr. Young said that they had been looking round for five or six years and had not been able to find an instrument that would usefully tell the variations volume of the air passing into the cupola.

Mr. Wise proposed a vote of thanks to Mr. Young for his Paper, which was accorded in the usual manner.

LANCASHIRE BRANCH.

"HANDLING OF FOUNDRY MATERIALS."

At a meeting of the Lancashire Branch, held at the Manchester College of Technology on October 7, the Branch-President, Mr. J. Haigh, of Wakefield, read a Paper upon the "Handling of Foundry Materials" (particularly iron), in which he described the manner in which this problem was dealt with in a large foundry receiving, in normal times, more than 1,000 tons of material per week. He illustrated his remarks with a large number of lantern slides and by reference to plans, one of which showed the buildings with railway lines, narrow gauge track, storage bins, etc., and the other the interior arrangements and the overhead equipment.

Importance of Transport.

Mr. Haigh said the question of the best method of transporting and handling foundry material was a very large one, and in many respects difficult. Outside the foundry, inefficient transport was a frequent cause of annoyance and delay; inside, bad lifting tackle and insufficient handling facilities gave rise to grievous complaints. There were probably more make-shift arrangements in the foundry than in any other department; even at the present time, in some cases in this country, iron, coke, etc., were carried by men on to the charging platform.

The cost of putting materials into the yard was often determined by the geographical situation, the relation of the foundry to the railway sidings or the canal wharfage. In the case he was dealing with all the material was received by rail, and, if storage accommodation was available, it went directly to the place where it was to be used. Direct siding accommodation, or proximity to a railway, gave a firm a primary advantage over another firm situated farther away which had its materials carted in and out of the works. This advantage, however, might be lost if, owing to faulty arrangements inside the works, material had to be handled and rehandled repeatedly. All material, when received, should be stored as near the place where it was to be used as was possible.

A foundry equipped with good lifting appliances was likely to turn out work more quickly and expeditiously than one badly equipped. In many cases the craftsmanship of the moulder rose superior to his environment, and many good castings were produced in badly equipped foundries. This, however, was no apology for bad tackle. One should be alive to the use of modern equipment, and able to take advantage of it when the opportunity was given.

It was impossible on this occasion to deal exhaustively with so large a subject, and he did not propose to enter into a controversy as to whether alternating or direct-current motors were most suitable for foundry work, or at what stage it was advisable to give up the use of compressed air lifts in favour of electric lifts. There were many vexed questions, such as the uses to which electric magnets can be put, also grab buckets for dealing with sand, slag, etc. Given sufficient space, most of these modern appliances could be used to advantage, but if one was working a foundry started 25 to 50 years ago, and which had grown with the business, it was very difficult—in many cases impossible—to use those appliances on an economic basis. On this occasion he would deal with what was actually being done, and done successfully.

Mr. Haigh proceeded to describe in detail the principal features of the arrangements made. All cupola materials entered the works at one point, and were distributed from there. Sand, blacking, gas coal, etc., came in by another road. Coal was unloaded direct on to the stage, and any surplus was put into stock. Blacking was delivered at the mixing shed; the sand went direct to the loam mills or to the sand mixing bay. Generally, all material not required immediately went into stock. Waste sand was removed by tipping wagon (wherever possible) or by barrow, and deposited in bins, where it could be loaded into railway or motor wagons. The waste sand from the tube fettlers was removed by conveyor, and the trucks were loaded simply by opening and closing the valve. The jig cranes in fettling shops had pneumatic hoists or lifts, and were used largely for turning the castings on end for emptying the sand.

Ladle Receiver Advocated.

The branch foundry, with a capacity of 12 tons per day, was used for making small castings, largely snap flask work. In describing this the author gave particular attention to the methods of handling the moulding boxes and the molten metal. He said he did not favour the tapping of metal direct from the cupola into shanks, and it was only permitted in exceptional cases. Metal was tapped into the ladle and poured from there into shanks. He asked the members to note the type of bogie used, and explained that the reason for throwing out of centre was that it allowed the shanks to get closer under the lip of the ladle and facilitated the emptying of the ladle. In distribution the metal was taken as near the man as possible. For the longer boxes the ladle was hoisted from the truck and the moulds poured direct from the ladle. Smaller boxes were poured from a wheeled ladle. Snap flasks were hand shanked.

The main foundry was laid out for the production of upwards of 150 tons of castings per day. In normal times 200 tons of metal were frequently melted in four cupolas. Over each cupola was a jib crane, with electric controller well out of the way. If metal was required for the shanks these were filled from the ladle while it was suspended. Easy hoisting and lowering greatly facilitated the filling of shanks and wheel ladles, and the men could stand comfortably whilst the shanks were being filled. Metal required for heavier work was placed on a bogie with ball bearings, with specially constructed carriage near the ground for safety. One man could move a ton of metal.

Discussion.

MR. O. STUBBS remarked that Mr. Haigh had given the members so much to think about that the discussion ought to be adjourned to the next meeting. It would be an injustice to so excellent a Paper on so important a subject to attempt to dispose of it at the end of a meeting which had been largely occupied with other matters. The American system of transportation was absolutely overhead, and some information about it would be of interest.

MR. HAIGH suggested that Mr. Stubbs might give the members the results of his own observations of American practice.

MR. HOGG, in moving a vote of thanks to Mr. Haigh for the Paper, said the figures of the output of the foundries with which the Paper dealt showed the responsibility that devolved upon Mr. Haigh in connection with it, and the amount of experience which gave weight to his statements.

MR. MASTERS seconded the vote of thanks. He remarked that in the pictures thrown upon the screen he had observed signs of the master mind which had carried out the work of transforming an old shop into a new one. What was the thickness of the tubes which were turned out of the foundry? There were other members interested in that type of product, and if they knew the thickness they might be surprised.

MR. CAREY HILL said, as a visitor, he wished to support the motion. He had attended meetings of the Midland Branches, as well as the meetings of his own branch at Coventry, but prior to this occasion he had not had the opportunity of attending a branch meeting or lecture in the North. It

was with very great pleasure that he had listened to the Paper. In his own district the foundries were on a smaller scale than the one which had been described; they dealt with smaller work, and the weight and volume of the materials was very much less. Therefore the problem of transport was less difficult. But one could learn a great deal by listening to the experience of those who worked in other foundries, even though the circumstances were not alike and the practice somewhat different.

Mr. Sydney Smith said it was not an easy task to arrange a good jobbing foundry. The predominating need was that the materials should be handled by the simplest possible methods. Everything that went into the foundry should go in one way, and everything that came out should do so by another way. He would like to have Mr. Haigh's opinion on the question whether the rectangular pit or the circular pit was the better method.

The vote of thanks was passed unanimously.

Iron in Copper and its Alloys.

Dr. F. Johnson, the new Chairman of the Birmingham Local Section of the Institute of Metals, opened the new session with a Paper on "Iron in Copper and Copper Alloys," remarking that, whilst to some manufacturers iron was an extremely undesirable ingredient, to others its presence afforded neither alarm nor pleasure. He went on to say that for the copper refiner iron had few terrors, as it was one of the most readily oxidisable impurities. In an impure black copper a percentage of 3.037 per cent. of iron was brought down to 0.008 in the refined ingot. The tenacity with which iron clung to copper during the smelting stages was succeeded by a feebleness of union during the refining stages.

The toughening influence of iron on arsenical copper doubtless was largely the result of a deoxidising action, as was also the immunity of the ferruginous bars from the embrittlement undergone by ordinary "tough-pitch" copper when heated to a high temperature in a reducing gas.

The alloying of copper with iron was by no means easy, as the rate of interdiffusion was slow and the melting points of the two were widely different. According to Stead, copper could take up 2.73 per cent. iron in solid solution, and iron could take up 10 per cent. copper. Aluminium was very effective in promoting the uniform alloying of iron and copper. An important application of this influence had been discovered in connection with copper-aluminium-iron alloys and the so-called manganese bronzes. Iron did not destroy the machining properties of copper alloys, whilst the addition of iron to copper-aluminium alloys—for example, aluminium-bronze—was beneficial in preventing crystal growth. The importance of iron in reducing the grain size could not be too highly emphasised, for one of the greatest sources of weakness in large castings, such as propellor blades, was a coarsely-crystalline structure. High-strength brasses were now made which would give a yield point of 20 tons per sq. in. and a maximum stress of 40 tons per sq. in., with 20 per cent. elongation from any part of the casting.

There did not appear to be any favourable expert opinion concerning the presence of iron in brass which had to be subjected to corrosive influences. In copper-aluminium alloys iron increased the yield point and tensile strength at the expense of ductility, whilst in gun-metal iron, according to Gulick, raised the tensile strength and lowered the elongation. The author's own experiments with small chill castings showed that iron in the proportion of 0.35 per cent. had a beneficial influence on the mechanical properties, whilst the same remark applied to the influence of 1.0 per cent. iron accompanied by 0.16 per cent. aluminium. The effect of iron alone was to make the alloy sluggish in pouring, but the presence of a small quantity of aluminium restored the fluidity. In Admiralty gunmetal iron did not appear to be detrimental if correctly alloyed, and under such conditions the mechanical properties were improved.

Book Reviews.

"Water Power in the British Empire." By Sir Dugald Clerk, K.B.E., F.R.S., and Prof. A. H. Gibson, D.Sc., M.Inst.C.E. Published by Messrs. Constable & Company, Limited, London Price 3s. 6d.

This work is a collection of the Reports of the Water-Power Committee of the Conjoint Board of Scientific Societies. The importance of water power to the metallurgical trades of Great Britain is not generally realised. Whenever a large source of water power is available in a distant land the exploiters generally examine the possibilities either of smelting iron ore, should this mineral and charcoal be available in the region; or should quantities of scrap be available (as existed in South Africa from the mines and railways), the making of steel on site.

Obviously, it takes some time before sufficient skill is obtained to produce iron or steel adequate for local purposes, but a time is bound to arrive when such Colonial plants will be able to satisfy local demands, to the prejudice of our metallurgical export trade.

The installation of electric steel furnaces during the last decade in South Africa, Australia, Canada, to say nothing of Spain and Italy, must have acted detrimentally to Sheffield's export business, as for every ton of special steel made in these furnaces less is imported, in which business Britain has had the lion's share.

The above, superficially, indicates that it is detrimental to British interests to help in any way the exploitation of Colonial water power. Such, we believe, is a fallacy, as the opening up of a Colonial industry brings trade in other directions. Primarily there is the supply of the original plant, then means of transport, then building materials. With this comes all the diverse material which go to make villages, towns and cities. Whilst some of our Colonies may be in a position to supply the bulk of its own material, nature is so made that no country can be self-supporting. Even the United States lacks rubber, manganese and nickel—three very important commodities. It is thus essential that every engineer and metallurgist should not only be alive to the water-power possibilities and developments in the vast British Empire, but get interested in them from their inception. It is estimated that there exists in the British Empire some 70 millions of continuous potential horse-power, whilst only 15 to 16 millions are as yet developed throughout the world. We do not intend to digress upon the exhaustion of coal and the future of water power, for these subjects, associated with the exhaustion of workable iron ores, the extraction of aluminium from clay, the wireless transportation of electric power in bulk, lead one into the realms of conjecture. Amongst the recommendations made by the Committee, of which the authors are respectively chairman and secretary, are State aid for development where necessary, specialised University training, and an Empire Conference in the near future.

Shop Arithmetic for Machinists, by Erik Oberg. Published by the Machinery Publishing Company, Limited, 51 and 52, Chancery Lane, London, W.C.2. Price 5s. net. Whilst this book is primarily intended for men in machine shops and tool rooms and students in mechanical engineering, there are several sections of distinct use to foundrymen. It is at chapter 7 where they can usefully start, as it outlines the use of formulæ. The chapters which follow deal successively with "Horse Power of Belting," "Time Required for Machining," "Areas of Plane Figures," "Volumes of Solids," and "Specific Gravity and Weights of Bar Stock and Castings." The mensuration portion is one which will help moulders to calculate accurately the weights of castings of a fairly regular form.

Mr. R. E. Higgin, 265, Deansgate, Manchester, and Mr. C. E. Ridley, 35-7, Dundas Mews, Middlesbrough, have been appointed agents for Lancashire, Cheshire, and the West Riding of Yorkshire, and for the North-East Coast, respectively, for Henry Joseph and Company, 96, Victoria Street, London, S.W.1.

An Apprenticeship Course in Foundry Practice.—XVII.

By Ben Shaw and James Edgar.

CORES AND CORE MAKING.

PART II.

Just as the green sand, dry sand and loam moulders have, as a rule, specialised in one particular branch, so the making of cores is now more or less a specialised occupation. In some foundries the core makers are divided into two groups, those who are responsible for the making of cores from oil or other artificially bonded sands and those who make naturally bonded sands; but in general a core maker is expected to be skilled in the preparation of sand mixtures, and to be able to make cores for any class of work necessitating cores, although a distinction is usually maintained between the loam and sand core makers. Frequently the core maker, besides being responsible for the making of cores, is also responsible for inserting them in their moulds, but this refers to complicated work in which a number of cores are involved, and when the coring up or assembling of the mould can be done with greater safety with the aid of the core maker. He is responsible for setting cores in their correct relation to each other and the mould, the final filling in of parts of cores which have been left for access to lifting staples, and in some cases for the testing of thicknesses. The part the core maker plays in the closing of a job varies with its size and intricacy, and to a considerable extent with the customary practice in any one foundry or district.

The degree of skill necessary in the making of cores is not less than that required in the preparation of moulds, and particularly in the making of cores for highly complicated work; the difficulty is not so much the preparation of the mould, but the making and assembling of the cores. It must be remembered that many cores are required to be almost wholly surrounded with metal, and however much care is necessary in the formation of the moulds in which they are to be made, greater care is usually necessary when making the cores. This is essential not only to provide a surface which will produce a skin on the interior of a casting comparable with that on the outside, but also in order that they will vent freely and be easily removed from the casting. They must be sufficiently strong to be handled and to resist the liquid pressure of the metal and at the same time sufficiently weak to offer but slight resistance to the casting during the critical time of contraction.

Coremaking Machines.

Making cores by mechanical means is not so well emphasised as machine moulding, but there is ample room for its use in many foundries. The making of cores does not differ essentially from the making of moulds. The fact that the former gives an internal impression, whereas the latter is concerned more or less with external shapes, does not debar the use of mechanical means for making cores any more than for moulds. Many of the moulding machines can be readily converted into coremaking machines and become equally as profitable when used for that purpose. Probably the most common form of coremaking machine is that used for parallel cores of any sectional shape. There are two types of machines that are employed for this purpose, the rotary or conveyor and the plunger. The former (Fig. 1) is used solely for parallel cores, and although any sectional shapes can be made according to the dies used, they are usually circular, other sectional shapes not being used to the same extent as round cores. This type of machine works on the same principle as the ordinary mincing or sausage machine, sand being fed into the hopper to a worm or conveyor, which, on being rotated, forces the sand through a die and produces a core corresponding in sectional shape to the die through which it passes. The conveyor may either be operated by hand or by mechanical power, and cores ranging in diameter from $\frac{3}{16}$ in. to 7 in. are readily produced up to about 2 ft. 6 in. long. Special core plates are used to support the cores as they come through the die and upon which they are dried. An oil sand is usually used on this kind of machine, although flour may be added to give greater green strength to the core and so reduce the possibility of it collapsing as it is being pushed along the plate. Vents are formed in the cores as they pass the dies, and they vary according to the diameter of the cores. The plunger type of machine (Fig. 2) is not confined to the making of parallel cores, but it can be used for shaped cores which can be stripped from their dies or coreboxes in a vertical direction. This, however, necessitates loose pieces in the dies and makes their construction more involved ex-

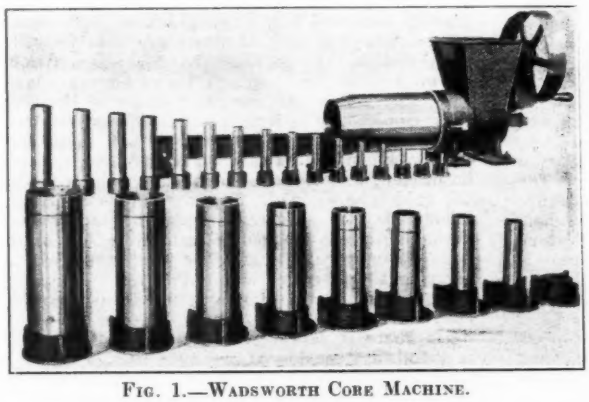


FIG. 1.—WADSWORTH CORE MACHINE.

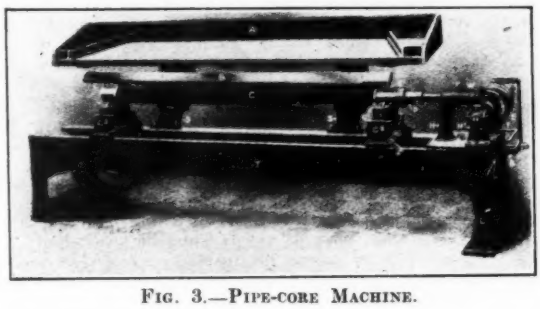


FIG. 3.—PIPE-CORE MACHINE.

FIG. 2.—PLUNGER-TYPE CORE MACHINE.

cepting for the simplest of irregular shaped cores. In this type of machine the die is fixed to a table and over a plunger of the same sectional shape as the bottom of the die. Sand is rammed in the die by hand and then vented when the core is stripped by means of the plunger. The plunger may be operated by a direct lever arrangement or by rack and pinion according to the type of machine used, and the sizes of cores vary from ¾ in. to 6 in. dia. and any length up to 9 in. Oil-bonded core-sands are not so suitable for cores produced on this machine, unless they have other bonds in their composition which increase the green strength of the sand, because they must be handled when they have been stripped from the die or core-box.

Another core-making machine especially designed for preparing pipe cores prepares the cores on a spindle or core barrel (Fig. 3). Ordinary moulding sand is rammed against the core barrel by means of a reciprocating steel bar as it revolves. Either green or dry sand mixtures may be used, according to the class of work for which the core is required. The machine is operated by mechanical power, which rotates the core barrel and operates the steel bar, but the sand is fed by hand. It has a wide range, being readily adjusted for any cylindrical cores varying from 2 in. to 21 in. dia. and any length between 9 in. and 9 ft. Larger machines are necessary to cope with larger cores. Probably the most useful machine which can be used for general purposes is the core-jarring machine. Any sized core-box may be used up to the capacity of the machine. The smaller types are usually set into the core benches with the operating table about the same height as the bench, but otherwise clear of it, so that the vibration will not affect the rigidity of the bench. The core-boxes are usually filled with the core-mixture by hand, which is then jar-rammed and the whole transferred to a plate for stripping preparatory to baking. Any core-mixtures may be used according to the special needs of the work. The only advantage of this type of machine is that it obviates hand ramming, excepting when the sand needs to be tucked into internal pockets, but it produces a core of more regular density without the hard and soft places common to the hand-rammed core, and it expedites their production. The larger types are used for large dry sand cores, many of which would otherwise be prepared in loam, and, as full core-boxes are necessary, in some instances they can only be profitably used when the number of cores required warrants the construction of a full core-box. The hand or power press machine is also used in the making of cores, and invariably some turnover device is used in conjunction with it to facilitate their production.

Cores for Repetition Work.

When quantities of similar cores are required for repetition work, such as small valves, pipe fittings, etc., a number of cores are usually prepared at one operation from a multiple core-box, which carries the impressions for many half-cores, the number depending upon their size. These multiple core-boxes may be composed of some composition, such as is used for match-plates, or they may be cast in metal. Cast-iron is sometimes used for this purpose. They may be prepared in halves, with suitable guide-pins for use on a press machine, or the one plate may be used on a jar-ramming machine to produce half-cores, which are afterwards pasted together. An illustration of such a multiple core-box is shown in Fig. 4. When an oil-bonded sand is used, the cores need to rest flat on a plate or be supported until they are baked. It is, therefore, convenient to prepare them in halves, venting before they are stripped, so that they can rest flat on a plate, but in order to save time in pasting, the complete cores may be made and supported on shaped plates for baking. Such cores need no rodding, and they shake out readily after the castings have been made. Although oil-sand cores are very weak when green, they are very strong and easily handled after being dried, and as long as the cores are sufficiently small to be handled without the aid of cranes, rodding or the use of grids is almost eliminated. Projecting parts of comparatively small sectional area may be wired or brads may be used, and these are generally sufficient, after which the cores may be inserted in their moulds either directly by hand or suspended on tapes or string; but when the crane is used and it is not possible to use a fibre or leather sling about the core, some form of stiffening is necessary to provide staples for lifting and in order to support the core so that its weight is distributed. Generally when the cores are large and not capable of being handled it is customary to make use of naturally bonded core mixtures, not because these are necessarily better for such cores, but because they are relatively cheaper than artificially-bonded core mixtures, and the economical production of castings must not be overlooked. In some instances artificial binders are used to give additional strength to weak naturally bonded sands, but as the size of the cores increase, the economic value of special core-binders decreases; thus, except in special instances, naturally bonded core mixtures fulfil the average requirements for large and medium-sized cores.

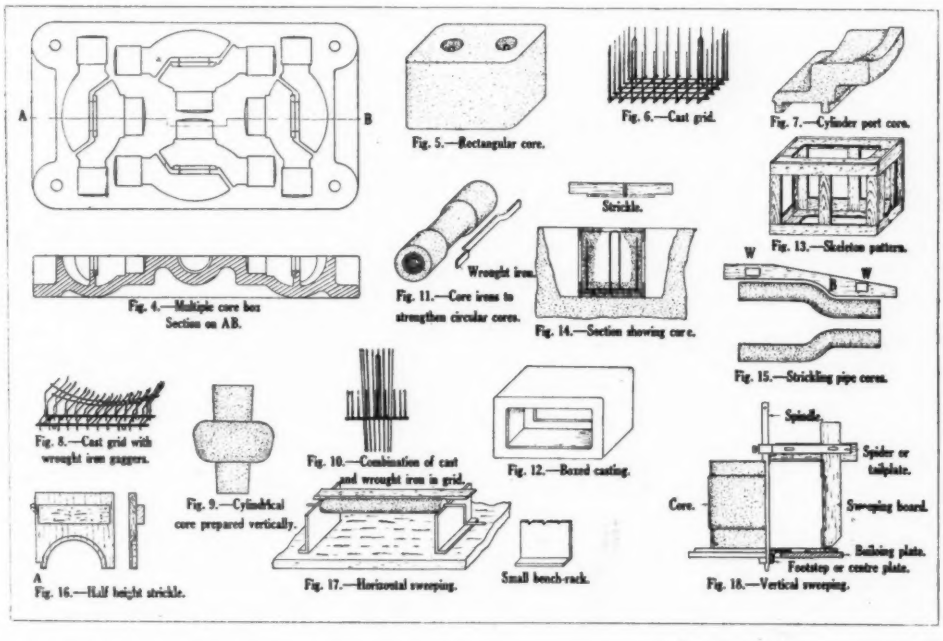
Core Grids.

With such cores some form of rodding or grids is necessary, but whatever the form of support to enable the core to be lifted, consideration must be given to the ease by which it can be removed from the finished casting. This is important when the area of the outlet, through which the core irons or grids must be extracted, is small. It is frequently necessary to use wrought iron in preference to cast iron, the ends of which are so arranged in the core that they are accessible near the outlet for drawing from the casting; then, however much they may follow the irregular shape of the core, they can easily be withdrawn. When cast iron support is given to a core which will leave comparatively small area for its removal the grid must be broken, and this fact must be considered when the grid is being made, otherwise much additional labour may be incurred in fettling the casting. Wrought iron is frequently cast into grids, or the cast iron may be only a minor part, and used for securing the pieces of wrought iron. Their use is very helpful when cleaning the casting, particularly when the cast part is easy of access for breaking. There is, however, another advantage which is not always considered, wrought iron is less rigid than cast iron, and it therefore offers less resistance to the core crushing during the time the metal is contracting. When there is ample room for the removal of the core the grid is made of cast iron, it being more easily made. Thus the simple rectangular core shown in Fig. 5 would need a grid such as is illustrated in Fig 6, whereas the grid for a cylinder steam core, such as is shown in Fig. 7, would be more easily made and have greater value if pieces of wrought iron are cast in a bar similar to Fig. 8, instead of attempting to make the grid wholly of cast iron. A grid composed of cast and wrought iron is also of value when the cast iron part is used near the centre of a core, and the sand above and below it needs support. Gaggers or prods can, of course, be formed on one side of the grid, and pieces of wrought iron cast in for the other. The core may be enlarged about the centre as in Fig. 9, and the cast iron part of the grid can be formed to strengthen the enlarged portion, whereas wrought iron cast in it, as shown in Fig. 10, will support the remaining parts of the core. Then with such cores as water jacket cores, that need some support for lifting purposes as well as to give strength, the inlet and outlet are, as a rule, so small that cast iron grids of any kind are out of the question. In such instances a wrought iron grid should be built and the parts wired together in order that the pieces can easily be separated and drawn out after the casting has been made. Shaped pieces of wrought iron are frequently used for strengthening a swept core when the spindle upon which it is swept is removed after the core has been dried. An illustration of this form of strengthening is shown in Fig. 11. A number of shaped pieces of flat iron are set into the core and wired into position before the final coating is applied to the core. It is necessary to exercise care in the making of grids, because they should offer as little resistance as possible to the core crushing under the strain of the metal when it is contracting.

Loam Core Making.

Although dry sand mixtures, whether naturally or artificially bonded, are commonly used for

smaller cores, and to a considerable extent for medium-sized cores, core loam is more frequently employed for large cores. In many foundries the use of sand for cores is limited to the smallest of cores, the remainder consisting of core loam. Much depends upon the material supplied from the patternshop from which cores are to be made as well as the common practice of the particular foundry. More patternwork is needed when core sands are to be used than when core loam is used. The sand needs to be rammed, and a substantial surface is necessary against which it can be rammed, whereas core loam does not need to be rammed, and skeleton or framed core boxes may be used. As a matter of fact, such boxes are better for loam cores because core loam is used wet, and it is advisable to reduce the amount of timber in contact with it as much as possible to prevent the wood varying in form, due to the absorption of moisture, from seriously affecting the size of the core. It is this form of core making material which is particularly suitable for making the core or cores in a skeleton shell pattern. A simple illustration of work of this character is shown in the boxed casting illustrated in Fig. 12. It is not necessary to make a block pattern and core-box, particularly if only one or two castings are required; the skeleton shell pattern, Fig. 13, fulfils the purpose adequately. The method usually adopted is to prepare a hole in the sand floor and set the pattern in on a level bearance with the top of the pattern about flush with the floor surface. In this position the moulder can proceed to make the core. Parting sand is applied to the bearance and a covering of core loam given, and into this is bedded a clay washed grid and more core loam applied, so that it follows the inside shape of the pattern and about 4 in. thick. Dried loam may be introduced in pieces here and there to stiffen the soft core loam more rapidly. The loam should, of course, bind round the gaggers on the grid, but the centre of the core may be left hollow until it is dried and returned to the mould, when sand may be lightly rammed in. When the pattern has been filled in this way and the core loam has been allowed to stiffen, a strickle checked back a thickness equal to that of the sizes of the pattern, is used to remove surplus loam from the sides in the manner shown in the section, Fig. 14. When this has been done and the surfaces sleeked, the remaining part of the work is done in sand. The complete outside shape of the pattern is made up with sand in the first place, after which the mould can be prepared.



Strickling and Sweeping Core Loam.

Besides being profitably employed for cores when full or skeleton core-boxes are supplied, core loam owes much of its value to the fact that it can be strickled or swept by means of strickles or sweeping boards having a profiled edge similar to the external shape of the core needed. Thus, the core for a pipe, required to connect two lines of piping that are not in a direct line with each other, may be made by means of a strickle and guide bar. Such a core would be made in halves on a flat bearance in the manner indicated by Fig. 15. The strickle, Fig. 16, is shown as a half-height board. It consists of a board about 1 in. or 1½ in. thick, having a semi-circular opening cut out equal in size to half the required core, and having one leg A cut to a definite size to suit the guide B (Fig. 16). That part of the strickle which is used to form the shape of the half-core is chamfered in the manner shown, leaving the profiled edge about ¼ in. thick. This is done in order to apply pressure on the loam and towards the core in formation as the strickle is being moved along. The process of making each half-core with such a strickle consists in first weighting the guide-bar, which may be in wood or iron, and then trying the strickle along it to locate the approximate centre of the proposed core. About this centre sharp or sea sand may be used if the core is to be more than about 6 in. diameter for venting. This obviates the necessity of cutting out the vent after the core has been dried. A bedding of core loam is spread over the bearance to the approximate joint shape of the core, and into this is bedded a grid or core iron; more loam is then applied and it is given the requisite shape by working the strickle in contact with the grid. Large half-cores are generally allowed to stand before they receive the final coating of loam, for which purpose it is thinned with water. Dried loam may be introduced into the core loam during the process of making the core, and this hastens the stiffening and at the same time reduces the possibility of the core sagging before it is dried. Usually some slight allowance for sagging is necessary when making the strickle, from 1-16 in. to ⅛ in. being made according to the size of the core. The guide must be reversed for the other half core. When the two parts are dried they can be wired or bolted together, according to their size, clay wash being applied to the joints before they are secured.

Strickles of varying shapes can also be used in conjunction with framed boxes for use with core loam, that would otherwise need to be full core-boxes if a dry sand mixture is intended to be used for the core, and reference will be made to those when core-box construction is under consideration.

Many cylindrical cores are made in loam, and the patternwork involved in their production is limited to profiled edged sweeping boards. When the cores are long in comparison with their diameter,

they are prepared on a spindle or core barrel which is rotated. The profiled edged board is located at a definite distance from the centre of the spindle determined by the diameter of the core required; this determines the amount of loam the spindle must carry and also the shape the core is desired to have. When the cores are large in diameter compared with their length, it is usually better to prepare them vertically. By this method the sweeping board is rotated, the core remaining stationary. For rotating the board a machined spindle is used, which revolves in a special footstep or centre, which, in many cases, engages the spindle sufficiently to maintain it in a vertical position when being rotated. To the spindle is secured a spider or tail piece to which the sweeping board can be fastened. In this way the board can be set at a definite distance from the centre of the spindle—by means of a gauge stick—and the core built on a prepared bearance, the board being rotated with the spindle to sweep the loam to the contour that it represents. The illustrations, Figs. 17 and 18, show the methods and the tackle usually employed in preparing cores about a horizontal and vertical spindle respectively. The making of large cores of this nature comes properly under the general heading of loam moulding, and consequently we propose dealing with sweeping work more fully when we deal with loam moulding.

Inventions.

In opening his Address before the Institution of Mechanical Engineers on Friday, October 20, EMERITUS PROF. H. S. HELE-SHAW, LL.D., D.Sc., F.R.S. (President), remarked that the year 1922 was the seventh-fifth anniversary of the foundation of the Institution of Mechanical Engineers. The kindred engineering societies in Belgium and Holland had celebrated their seventy-fifth anniversaries this year. Reviewing some of the recent outstanding features of the Institution's advance, and discussing the subject of engineering education, the President remarked that ten years ago an important step was taken by the Institution in the inauguration of their own examinations. These were instituted to ensure that those who could not produce satisfactory credentials from colleges and schools of engineering should give evidence that they had acquired knowledge of those principles of engineering science on which sound practice rests.

After some remarks on the general activities of the Institution, the President went on to discuss the question of scientific knowledge and invention, asserting that all progress, at any rate in mechanical science, must be in the nature of invention. Every fresh step taken, in which new ground was trodden, every new device or new mechanism or new machine of changed form, in which movement of parts differed or even if the object attained was different, could only result from the exercise of the inventive faculty. Even where it was necessary to duplicate indefinitely any existing machine or machine part, invention was required, and had in recent years been exercised in a wonderful way for production purposes. Here, again, if the manufacturing engineer was to hold his own in competition, new ground must be broken all the time. But this was exercising the same faculty as required for devising new designs, either of the complete machine or of the separate parts.

On the subject of futile inventions, the President remarked that engineers in practice, in the course of their work, constantly spent large sums of money on inventions which, if they were more plausible, were not less impossible than some extreme cases mentioned by the speaker. In ninety-nine cases out of a hundred a sound training in principles of physical and mechanical science would keep a man on sound lines and enable him to use that power which most of all distinguished him from a mere animal, namely, imagination. He had long thought that, beyond general engineering training, the time had come for an actual Chair of Invention, and still hoped to see such a Chair founded somewhere. Continuing, the President said that whatever impulse in the way he had suggested, or in any other way, the Institution might be able to give to invention, it must not be overlooked that by far the greatest inducement to invent was the protection afforded by the Patent Office. A patent was granted, not as some people thought because the Government had the slightest interest in that individual inventor, but simply and solely in the interests of the public, so that by the inducement of the reward in the form of a monopoly for a certain number of years the public might in return reap the fruit both of the genius of an inventor and of the expenditure of money by the capitalist necessary to produce and bring to fruition a successful invention.

There were certain matters in which their Institution might use its influence, suggested to the President by a friend of experience. One of these concerned the revocation of a patent, another designed to effect a clear understanding of the relation between employer and employee in matters of invention, another the rights of the Controller of Patents in regard to the power of refusing a patent for something which, although it might be new, was not, in his opinion, an actual invention, and, lastly, the introduction of something sorely needed between a patent and a design as provided for by German Patent Law. Taking these briefly in order, he would say that, while a patent could be opposed on the grounds that the invention had been made public by some publication or other, one could not oppose it on the ground that the invention had actually been made and sold. It ought to be possible, by proving to the Controller himself that such an invention had been actually made and sold, to give him the power to revoke a patent, or to oppose its being granted, whereas at present the only way of doing this was through the expensive proceedings of a High Court.

The second matter, namely, the relative rights of employer and employee, was a difficult one. It was usually met by some form of agreement which the employees were asked to sign. This was not fair to an employee. Under such an agreement an employee might make a valuable invention to which he then had no claim whatever. On the other hand, without such agreement, the employer might be providing all the money and paying the time of his draughtsman, who might proceed to take out a patent himself for what he had arrived at whilst he had been paid by his employer to do that very work, and whose ideas he might have incorporated in his patent. It should be quite simple to have an equitable arrangement by which there must be some sort of Court of Appeal which could adjust the proper shares in rights to each party in such cases.

Turning to the third matter, in Section 93 the Patent Office had power to refuse a patent on the grounds that it was not a new manufacture. At the present time, continued the President, this clause was being interpreted to mean that the Controller could refuse a patent on the ground that the subject matter, while new, was not an actual invention, or, as the Patent Law would put it, "not good subject matter." Now the question of subject matter being adequate or not should go through the Courts, with a final appeal to the House of Lords, but in the above Clause 93 the appeal was to a law officer who was Solicitor-General, and his decision was final.

To-day, when there was so little opportunity in mechanical engineering directions of far-reaching discovery, and consequently of a master patent, a cheaper patent for a short time (say a period of five or six years), ought to be granted for an improvement which might be of great value, although the matter might be a comparatively small one. For this a small fee might be charged (say £1 a year), enabling the inventor to introduce small improvements for which he would not receive adequate protection by registration of design, but which would be at once copied. Thus, after great expense in the way of experimenting, devising, and making patterns, he found a week or two afterwards that his actual device had been copied, even put on the market, even perhaps been actually used with a trivial alteration as a pattern to mould from. Engineers would appreciate the discouragement to progress which the absence of protection produced in cases of this kind.

THE METROPOLITAN VICKERS ELECTRICAL COMPANY, LIMITED, have opened their new showrooms situated in Chapel Walk, Sheffield.

Trade Talk.

THE ELECTRICAL ALLOY COMPANY has removed from 4, Regent Square, to 281, Gray's Inn Road, W.C.1.

HALL & PICKLES, LIMITED, Port Street, Manchester, are opening a new office at Oxford Offices, Oxford Row, Leeds.

A FURNACE is being put into blast at the works of the Barrow Hematite Steel Company, Limited, making a total of three blowing.

VICKERS, LIMITED, Barrow, have received an order for a set of Diesel internal combustion engines for a coasting vessel for Japan.

THE IMPORTS of foreign iron ore into Maryport last week amounted to 3,500 tons. This was the first consignment that arrived during October.

THE ADAMANT ENGINEERING COMPANY, LIMITED, have erected extensive new works at Dallow Road, Luton, which are now completed and installed.

BOLTON'S SUPERHEATER & PIPE WORKS, LIMITED, have removed their office and works from Trafford Park, Manchester, to Adswood, Stockport.

THE SPEARING BOILER COMPANY, LIMITED, have secured the contract for two water-tube boilers of 30,000 lbs. each from the Watford Corporation.

MR. GEORGE WALTER, coal, iron and steel agent, etc., has removed from 49, Leadenhall Street, London, E.C.3. to 10, Great St. Helen's, London, E.C.3.

THE IMPORTS of foreign iron ore at the Lonsdale dock at Workington last week amounted to 1,350 tons. Outward consignments included 1,100 tons of rails.

THE OFFER FOR SUBSCRIPTION of £1,000,000 5 per cent. debenture stock of Pease and Partners, Limited, was made on Thursday. The stock was issued at 93 per cent.

HOGAN BROS. AND COMPANY, 44, South William Street, Dublin, have been appointed agents in the Irish Free State for the Holland Insulated Wire and Cable Works, Amsterdam.

MR. J. P. SCARRATT, of 6, Hunter Street, Liverpool, has been appointed agent in North Wales for Johnston & Young, iron and tinplate merchants, 4, Queen Street, Old Hall Street, Liverpool.

FRY'S METAL FOUNDRY, of 25-42, Holland Street, Blackfriars, London, S.E.1, have acquired the business of the Light Casting & Patternmaking Company, Limited, Hillside Foundry, Kingsbury Road, Kingsbury, N.W.9.

THE improvement in trade enabled the Conciliation Board meeting in Nottingham, on October 26, to increase the rates of pay of blast furnacemen and ironstone quarrymen in the Midland area by 1¼ per cent. on the percentage over base rates.

PRINCEPS AND COMPANY, engineers, who recently removed their head office from Matilda Street to 14 and 17, Wentworth Chambers, Pinstone Street, Sheffield, have re-appointed Mr. T. T. D. Geesin, of 4, Clevedon Road, Penge, S.E.20, as their London representative.

MESSRS. G. CURTIS HOLT & COMPANY, LIMITED, who specialise in air compressors, receivers, moulding machines, and cupola blowers, have opened a branch at 5, Blackfriars Street, Manchester. Their headquarters still remain at 2, Basinghall Street, Leeds.

LICENCES under the Non-Ferrous Metal Industry Act, 1918, have been granted to the Anglo-Russian Black Sea Development Company, Limited, 20, North John Street, Liverpool; Jackson & Walker, 86, Two Trees Lane, Denton, near Manchester; and the Ynis Bronze Company, Limited, 69, Leadenhall Street, London, E.C.

THE SHEFFIELD ROLLING, FORGING, AND TILTING TECHNICAL SOCIETY held its second meeting in the Mappin Hall on October 27. Professor Desch, who was to have given an address on "The Scientific Equipment of Steel Works," was unable to be present owing to indisposition, but Dr. Longmuir contributed a paper on "The Reading of a Specification." Mr. Slater Willis presided.

THE VICTORIA BRASS FOUNDRY COMPANY, LIMITED, Bonnington Road, Leith, Edinburgh, have placed an order with Ritchie, Hart & Company, Limited, of the Mountpottinger Foundry, Belfast, for a core-making machine, to deal with stern tube liner cores, of 30 in. dia. and 25 ft. long, whilst Babcock & Wilcox, Limited, have ordered a foundry floor dressing machine from the same firm for their Renfrew works.

THE opening meeting of the session in connection with the Staffordshire Iron and Steel Institute was held at the Education Offices, Dudley, on October 28, when the following were elected members:—Messrs. A Madeley, manager of nut works J. Chadwick, forge manager, and T. Hoskison, manager at the Earl of Dudley's Level New Furnaces. The president, Mr. Jos. Payton, in his address, reviewed the industrial situation. Subsequently an address was given by Mr. F. J. Cook on his American experiences in connection with the iron and steel industries.

Company News.

Allufix Metal Company, Limited.—Capital £5,000 in £1 shares. Directors: Col. W. H. Briggs, J. G. Crossman, and J. Kilby.

Arjayco, Limited.—Capital £100 in 1s. shares. Ironfounders. Directors: G. M. C. Hart-Smith and C. C. Raven.

Boston Engineering Company, Limited.—Capital £3,000 in £1 shares. Directors: F. Hopper, E. Brotherton and J. Oldridge.

Charles D. Phillips, Limited, Emlyn Engineering Works, Emlyn Street, Newport, Mon.—Capital £75,500 in 75,000 ordinary shares of £1 and 2,000 employés' shares of 5s. Engineers

Effingham Engineering Company, Limited, Parliament Mansions, Victoria Street, London, S.W.1.—Capital £1,000 in 1s. shares. Directors: C. Pillow and C. A. H. Wood.

Frank Cryer, Limited, Jessop Street, Castleford.—Capital £5,000 in £1 shares. Engineers and ironfounders. Directors: F. Cryer, Florence M. Cryer, A. Gregory and G. Gregory.

J. & S. Leaver, Limited, 16, Eanam, Blackburn.—Capital £4,000. Mechanical engineers, machinists, etc. Directors: S. R. H. Leaver and N. Leaver (secretary).

K.B. Patents, Limited, 78, Petty France, Westminster, London, S.W.1.—Capital £500 in £1 shares. Ironfounders, mechanical engineers, etc. Directors: R. W. H. Kane and F. Badcock (both permanent).

Mantle, Sons & Company, Limited, Bayford House, Upchurch, Sittingbourne, Kent.—Capital £2.500 in £10 shares. Founders, engineers, etc. Directors: A. W. Mantle (managing director) and J. H. S. Mantle.

Midland Manufacturing Company, Limited, Celtic Works, Savile Street, Sheffield.—Capital £10,000. Mechanical engineers. Director: Mr. T. J. Fryer.

Regent Sheet Metal Machine Tool Company, Limited.—Capital £15,000 in £1 shares, to acquire the business carried on by Regent Shears (1918), Limited, at Wakefield. Directors: T. Black, L. N. Ledingham, and W. M. Black.

Rowe, Hyde & Company, Limited.—Capital £800. Engineers, etc. Directors: D. S. Rowe, H. A. Hyde and L. W. Gomer.

Renold Chains, Limited, Burnage Works, Burnage Lane, Didsbury, Manchester.—Capital £10,000. Directors: Hans Renold, C. G. Renold, W. H. Jackson and H. G. Jenkins.

Gazette.

WESTWOOD ENGINEERING COMPANY (WIGAN), LIMITED, are being wound up voluntarily, with Mr. G. H. Turner, Arcade Chambers, Wigan, liquidator.

MESSRS. W. SADLER, J. WAGER AND L. SEDDON, electrical and mechanical engineers, 276A, Buxton Road, Stockport, trading under the style of the Stockport Electrical and Mechanical Engineering Company, have dissolved partnership.

THE partnership heretofore existing between Messrs. R. Stewart and J. Drummond, electrical engineers, 23, Grange Road, Darlington, under the style of the Tyne & Tees Electrical Company, has been dissolved. Mr. J. Drummond continues.

MESSRS. H. CROSSLEY, R. Leach and B. Overfield, brass founders, finishers and engineers, Cowhill Brass Works, Oldham, trading under the style of Crossley & Company, have dissolved partnership. Mr. H. Crossley and Mr. R. Leach will continue.

MESSRS. V. F. P. THOMPSON AND S. D. MORGAN, carrying on business at 45, Horseferry Road, Westminster, London, S.W.1, under the style of the Standard Concrete Machine Company, have dissolved partnership. Mr. Thompson continues the business.

A PETITION for the compulsory liquidation of the Sheffield Steel Products, Limited, was before Mr. Justice Lawrence in the Companies Winding-Up Court on October 31. Counsel for the petitioning creditors said that the assets of the Steel Products Company were under the control of Sir William Peat, of Messrs. W. B. Peat & Company, chartered accountants, as receiver for the holders of the debentures, of which there were two issues, amounting to more than a million. It was hoped that a scheme of reconstruction could be brought about, and he suggested an adjournment until next sittings. His lordship adjourned the petition as suggested.

MR. J. B. TOMPKIN, governing director of Flockton, Tompkin & Company, Limited, Newhall Steel Works, Sheffield, who died on August 5 last, left estate of the gross value of £112,489, with net personalty £109,585.

IRON AND STEEL MARKETS.

Pig-iron.

In reviewing the present position of the pig-iron industry, perhaps the most reassuring feature of the conditions is a slight increase in the volume of home demand, which, although still confined within the limits of immediate requirements gives indications of an ultimate return to a normal average consumption. Recently, of course, smelters have been largely dependent upon exports for an outlet for their production, and while the Transatlantic demand continued had little difficulty in disposing of the furnace outputs with the additional advantage of disposing of the heavy stocks of iron accumulated during the slump period. Some idea of the extent of the relief thus provided is afforded by the returns of shipments of iron from Tees-side ports in October, the total to the United States amounting to 28,628 tons out of 66,381 tons, the shipments to American ports in September having accounted for 31,119 tons. Shipments to Germany dropped from 8,460 tons to 1,030 tons, a result, no doubt, of the collapse of the exchange. Italy was up from 2,205 tons to 3,054 tons, and other substantial buyers were:—Belgium, 3,826 tons, a slight decrease; Finland, 1,685 tons; France, 1,295 tons; and Sweden, 1,928 tons. In the Midlands furnace production is still on a limited scale, but at Birmingham market last week signs of returning activity were distinctly perceptible, although progress in that direction is still hampered by the high prices of fuel, coke prices having been advanced quite 3s. per ton, equalling a sum of quite 4s. 6d. per ton extra in the production of a ton of pig-iron. In the Glasgow iron market the cessation of American buying has resulted in a small decline of values for Scottish pig, and business consequently is quiet. Imports of Continental iron to Clydeside are also on the increase, and the low prices quoted are adverse to the interests of the home producer. On the North-East Coast business is again on a restricted scale, the uncertainty of the political position doubtless influencing conditions to some extent, while American buyers are now adopting a more cautious attitude. At present transactions on United States account are principally confined to orders for foundry iron to special analysis, with low phosphorus content, makers of these qualities being well booked over the remainder of the year. On the whole it may be said that a more optimistic view of the trade prospect is taken by Cleveland ironmasters, a partial resumption of American buying being anticipated, while a satisfactory increase in home inquiries has apparently justified the restarting of additional local furnaces by Pease & Partners, Limited, and the Lackenby Works. Current quotations are firmly maintained as follow:—No. 1 and silicious, 97s. 6d.: No. 3 G.M.B., 92s. 6d.; No. 4 foundry, 90s.; No. 4 forge, 85s.

The East Coast hematite market maintains its strength, with a steadily improving home demand. For East Coast mixed numbers 93s. is now demanded, though here and there this could be shaded for reasonable quantities. The premium for No. 1 is unchanged at 6d. to 1s. per ton. In the export trade there is a good deal of inquiry from the Continent, but it is not surprising that at the moment it leads to very little business. Trade with Italy has been interrupted by the Fascisti trouble, and Germany just now is right out of the market, though Belgium continues to buy moderate quantities.

Finished Iron.

Improvement in demand for finished material, although admittedly progressive, continues lamentably slow, and in the South Staffordshire market business is still restricted in scale, with inquiries, however, in slightly better volume. Reports of substantial wagon orders having come to this district, however, encourages the hope that the period of severe restriction and stagnation is gradually being left behind. In most respects, however, the industry is scarcely less disorganised and irregular than it has been for so long. There is still very keen foreign competition in some lines, while spasmodic incursions by home makers in other districts occasionally upset market prices in a most discouraging way. Another depressing effect is that the prices obtainable under the best possible circumstances are barely remunerative. Manufacturing costs are still far too heavy in relation to the selling prices which are possible in this market, and while fuel remains so dear there is little hope of relief. Makers of bar iron of marked qualities are still more fortunately placed than other members of the trade producing the commoner brands, the latter being subject to considerable foreign competition from French, Belgian and German producers. Prices are consequently irregular, makers being often compelled to accept orders at lower rates to keep plants running, very often at substantial pecuniary sacrifice. The shipments of manufactured iron and steel during October amounted to 38,598 tons, as compared with 26,677 tons in September, an increase of 11,921 tons. India and Ceylon took 13,947 tons, as against 8,060 tons, and 3,056 tons went to Portuguese West Africa. Australia received 4,108 tons, against 2,693 tons, and Japan 2,199 tons, against 1,497 tons.

Scrap.

A rather better feeling may be noted in some sections of the scrap metal trade, chiefly confined as previously to that for heavy steel material for which an increasing demand is in evidence. Accepting the Tees-side market as representative of the general tendency in the scrap trade, reports from that district indicate a steadily growing inquiry for heavy steel, the price of which is strong but unchanged at a minimum of 68s. per ton. Heavy steel turnings are also an active market, with the price firm at 54s. There is a little doing in c.i. borings at 52s. 6d., and there are indications of improvement in heavy machinery quality cast-iron scrap, which is obtainable at about 75s. to 77s. 6d. per ton. Ordinary descriptions are quoted at about 70s. to 72s. 6d. There is no effective demand for heavy wrought iron, and prices are nominal at 55s. to 57s. 6d. for bushelling, 60s. for ordinary heavy piling, and 70s. to 75s. for specially selected heavy forge. All prices are delivered works.

Steel.

Conditions in the various steel-making centres are again reported quiet, but there are certainly more inquiries in evidence, although individually limited in quantity, yet amounting in the aggregate to a fairly substantial tonnage. At present there is very little doing in acid billets, but basic billets are selling with some freedom. There is also an active demand for

(*Continued on page* 396.)

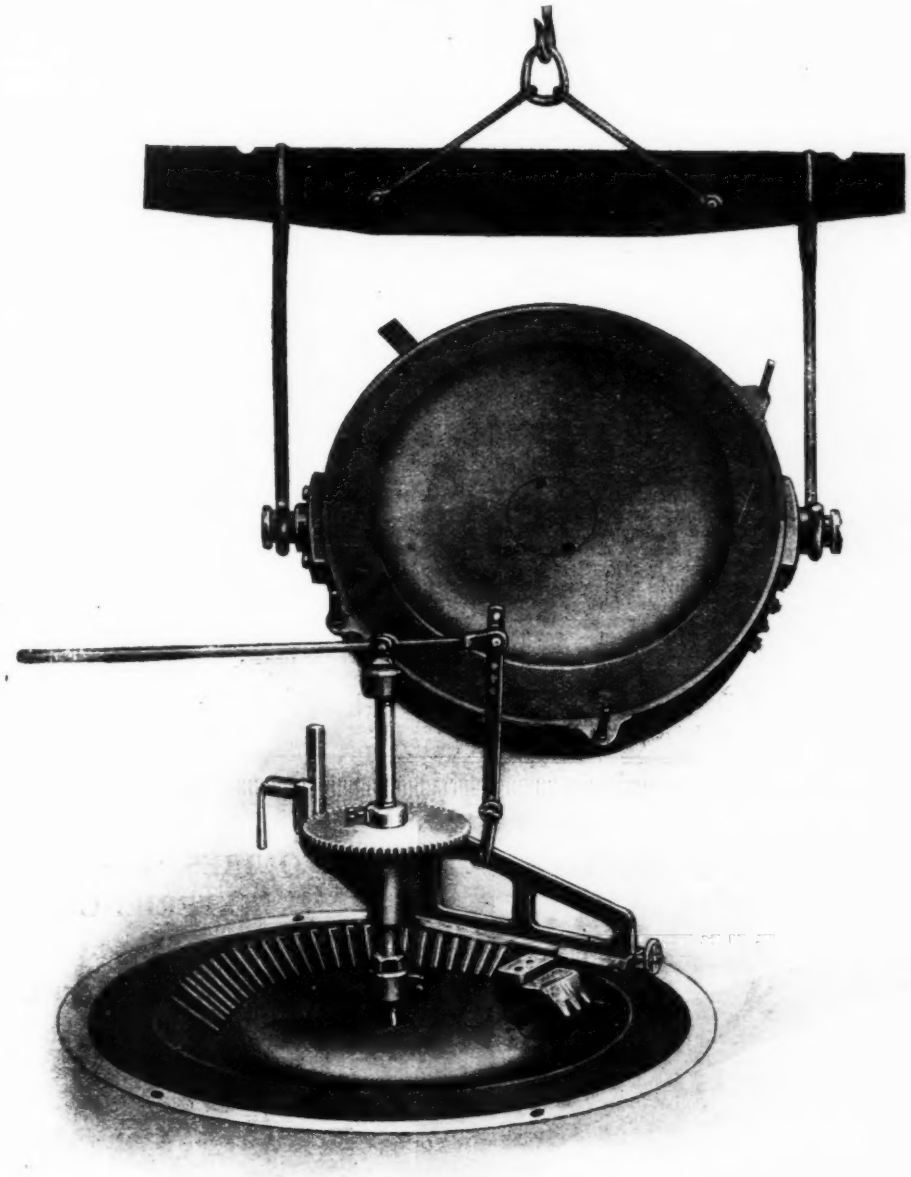
Grain Chill and Steel ROLLS,
HEAVY CASTINGS,
IRON up to 100 Tons. STEEL up to 40 Tons.
Special Air Furnace. *Siemens' Steel Only.*
R. B. TENNENT, Limited,
COATBRIDGE, N.B.

DO YOU USE——
"SIFCO"
INDESTRUCTIBLE IRON CEMENT ?
IF NOT, you have still to find the most essential Foundry economy. Entirely supersedes the ordinary stopping. Send for sample and booklet describing the uses of this wonderful product. Agents wanted where not represented.
Sole Manufacturers: SIFCO LTD., STOWMARKET.

A Comparison of British and American Foundry Practice,
With special reference to the use of Refractory Sands. 4/6 net.
By P. G. H. BOSWELL, D.Sc., M.Inst.M.M., etc.
George Herdman Professor of Geology in the University of Liverpool, late Scientific Adviser (Geological) to the Department of Iron and Steel Production, Ministry of Munitions.
The results of a detailed study of American foundries and steel works, being the first attempt to compare the British and American methods and conditions; a sequel and supplement to the author's previous publications, including a large amount of new data.
UNIVERSITY PRESS OF LIVERPOOL LTD. HODDER AND STOUGHTON LTD., LONDON.

The "VULCANIA" PATENT WHEEL MOULDING MACHINE.

Patent No. 5049.



THE "VULCANIA" PATENT WHEEL MOULDING MACHINE is for moulding spur wheels with straight, sloping or Vee-shaped teeth, also bevel wheels, skew gear wheels, worm wheels and internal wheels. The machine head is carried on a pillar which is held in a base-plate bedded in the floor sand, and is made to slide on the pillar by means of a lever and link carried on a joint bearing, or by rack and pinion, or screw if thought advisable for the particular work it is being used for.

An adjustable stop collar is provided for accurately deciding the depth of mould. On the removable head a slide is carried for supporting the patterns of the teeth to be moulded. This slide is made adjustable by screw or pinion gearing to the diameter required. The number of teeth to be moulded is decided by a special dividing plate into which a steel wedge or finger engages. The special dividing plate has milled vees, at the angle of 60° inclusive, around its circumference, to receive the steel wedge, which is adjusted by a screw having an internal spring to keep it in tension and to lock the head when ramming operations are being carried out.

JAMES EVANS & CO., BRITANNIA WORKS,

(MANCHESTER), LIMITED.

BLACKFRIARS, MANCHESTER.

basic steel of the cheaper kinds, and more furnaces are now in operation than for months past on this material. With reference to high-grade steel, however, conditions are different, for little more than a fourth of the furnaces in the Sheffield district devoted to its production are employed at the present time, and so far as can be judged the position is not likely to improve just yet. The home demand for ferro-manganese remains fairly good, but the present output appears sufficiently large to cover probable requirements for some time. The price of 76 to 80 per cent. material is unchanged at £15 for the home trade and £14 10s. for export. In the United States sales have been for a few small lots, on which the usual price of $67.50 c.i.f. tidewater was done. This figure is equivalent to $101.10 duty paid at tidewater for 80 per cent. metal. Dealings in the tinplate market of late have been fairly active, the business passing having been transacted on the minimum fixed price of 19s. 6d. per box and upwards for IC 14 by 20, 112 sheets, 108 lbs. in coke finish, net cash, f.o.b. Wales. The rise in tin is, of course, an important factor, and makers of tinplates are by no means anxious to book option contracts at the fixed price.

Metals.

Copper.—Messrs. Henry Bath & Son, Limited, in their fortnightly metal report, state :—Fluctuations during the past fortnight have been moderate, with, generally, a rising tendency. The lowest price touched for three months was £62 7s. 6d., and the highest £64 per ton. Home demand has been continuous, but moderate. There has been such a steady absorption of the scrap arising from the breaking down of war material, etc., that these supplies are, comparatively speaking, now worked off, and consumers are falling back more and more on virgin metal. A big increase in Chilean production is apparently a matter of perturbation to the American producers, in spite of the fact that American consumption has expanded materially and is still quite good. Current quotations : —*Cash* : Wednesday, £62 17s. 6d. ; Thursday, £62 15s. ; Friday, £62 12s. 6d. ; Monday, £63 5s. ; Tuesday, £63 10s. *Three months* : Wednesday, £63 12s. 6d. ; Thursday, £63 10s. ; Friday, £63 10s. ; Monday, £64 ; Tuesday, £64 5s.

Tin.—The advance recorded in our last continued steadily until a sharp rise at the beginning of this week culminated in an excited market on the 31st ult., when £186 15s. was paid for three months. Heavy realising has caused a fall, with sharp fluctuations, of about £7 per ton. The turnover on 'Change has on some days reached exceptionally large dimensions, speculative buying and selling being freely indulged in. America has only been buying small quantities, whereas it is asserted that her uncovered requirements are very large. The East has sold fairly steadily at full prices but not in big quantities, and although shipments are well up to the average the figures of visible supply as at October 31 show a decrease of about 500 tons. Current quotations :—*Cash* : Wednesday, £180 5s. ; Thursday, £179 2s. 6d. ; Friday, £183 15s. ; Monday, £187 7s. 6d. ; Tuesday, £184 15s. *Three months* : Wednesday, £180 15s. ; Thursday, £179 17s. 6d. ; Friday, £184 5s. ; Monday, £187 15s. ; Tuesday, £185 5s.

Spelter.—A steady advance was seen in this market until the 26th ult., when £37 10s. and £36 were the closing quotations. Since then the market has been firm with slight alteration in price for near but with an easier tendency for distant delivery. The rise in price has led to America furnishing supplies to this market to the detriment of the limited available stock there. Supplies from the Continent continue very meagre. The galvanising trade is very busy and has bought freely. Current quotations :—*Ordinary* : Wednesday, £37 5s. ; Thursday, £37 5s. ; Friday, £37 10s. ; Monday, £37 15s. ; Tuesday, £37 17s. 6d.

Lead.—In the early part of the fortnight prices eased off until the 20th ult., when the quotations were £24 15s. and £24 7s. 6d. per ton prompt and forward. A somewhat unexpected shipment of about 1,500 tons of Mexican lead overshadowed the market, but the rapid absorption was followed by a quick recovery in prices, the market later experiencing an advance of £1 15s. per ton for October lead and £1 for forward. Sharp movements have continued, the highest quotation being on the 26th ult., viz., £27 for October, and £25 10s. for January. Home consumption is quite good, and in America the position is reported to be strong. The present level of prices, however, should bring out increased supplies. Current quotations :—*Soft foreign (prompt)* : Wednesday, £26 10s. ; Thursday, £26 ; Friday, £26 10s. ; Monday, £26 10s. ; Tuesday, £26 10s.

TO MAKE A CASTING LIKE THIS

REQUIRES YEARS OF EXPERIENCE.

IF YOU WANT STEEL CASTINGS

Write to—

WILLIAM BEARDMORE AND COMPANY LIMITED

PARKHEAD STEEL WORKS, GLASGOW.
or
LONDON: 36, VICTORIA ST., S.W.1.

Telephone: 21, Penistone. Telegrams: "Durranns, Penistone."

ESTABLISHED 1863.

JAS. DURRANS & SONS., LTD.

Phoenix Works, Penistone NEAR SHEFFIELD.

BLACKING
PLUMBAGO
CORE GUM
WHITE DUST
COAL DUST

Manufacturers of

FOUNDRY EQUIPMENTS.

Ladles, Cupolas, Fire Bricks, Ganister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, Etc.

Write for illustrated catalogue on Blacking and Foundry Requisites, also for our latest Price List.

ARE YOU SATISFIED

with the

QUALITY You are obtaining in **IRON &**
EXTRA PRICE You are paying for **STEEL**
DELIVERY You are getting of **CASTINGS.**

IF NOT, WHY NOT TRY

JOHN GILLOTT & SON,

'Phone 446.
'Grams "Gillott Barnsley." *Dominion Works, Barnsley.*

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	63	10	0
Three months	64	5	0
Electrolytic	70	10	0
Tough	65	10	0
Best selected	65	10	0
Sheets	96	0	0
India	84	0	0
Wire bars	69	17	6
Do. Nov.	69	17	6
Do. Dec.	69	17	6
Ingot bars	69	17	6
H.C. wire rods	74	15	0
Off. aver. cash, Oct.	62	16	5 5/28
Do. 3 mths., Oct.	63	8	11 5/11
Do. Settlement Oct.	62	15	10 10/13
Do. Electro, Oct.	71	0	0
Do. B.S., Oct.	66	11	1½
Aver. spot price, copper, Oct.	62	15	4¾
Do. Electro, Oct. 71	5	11	

Solid drawn tubes	13½d.
Brazed tubes	13½d.
Wire	10½d.
Yellow metal rods	6½d.
Do. 4x4 Squares	8½d.
Do. 4x3 Sheets	9½d.

BRASS.

Solid drawn tubes	11½d.
Brazed tubes	13½d.
Rods, drawn	10½d.
Rods, extruded or rolled	6½d.
Sheets to 10 w.g.	10d.
Wire	9½d.
Rolled metal	9½d.

TIN.

	£	s.	d.
Standard cash	184	15	6
Three Months	185	5	0
English	184	15	0
Bars	186	15	0
Chinese	183	15	0
Straits	186	2	6
Australian	185	15	0
Eastern	190	0	0
Banca	184	17	6
Off. aver. cash, Oct.	170	12	4 7/11
Do. 3 mths., Oct.	171	11	4 8/11
Do. Settlment Oct.	170	12	0 6/11
Aver. spot, Oct.	170	11	3

SPELTER.

	£	s.	d.
Ordinary	37	17	6
Remelted	34	10	0
Hard	27	15	0
Electro 99.9	39	0	0
English	37	15	0
India	28	15	0
Prime Western	37	15	0
Zinc dust	48	0	0
Zinc ashes	11	0	0
Off. aver., Oct.	34	0	6 3/22
Aver., spot, Oct.	34	11	4½

LEAD.

	£	s.	d.
Soft foreign ppt	26	10	0
English	27	10	0
Off. average, Oct.	25	1	3
Average spot, Oct.	25	11	3

ZINC SHEETS.

	£	s.	d.
Zinc sheets, English	40	0	0
Do. V.M. ex. whf.	40	10	0
Dutch	40	10	0
Rods	47	0	0
Boiler plates	39	0	0
Battery plates	39	10	0

ANTIMONY.

	£	s.	d.
English regulus	27	0	0
Special brands	33	10	0
Chinese	25	10	0
Crude	18	10	0

QUICKSILVER.

	£	s.	d.
Quicksilver	12	0	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d.
Ferro-silicon—			
45/50%	11	2	6
75%	19	10	0
Ferro-vanadium— 35/40%	17/- lb. va.		
Ferro-molybdenum— 70/75% c. free	9/6 lb. mo.		
Ferro-titanium— 23/25%, carbonless	1/2 lb.		
Ferro-phosphorus, 20/23%	£24		
Ferro-tungsten— 80/85%, carbon free	1/5 lb.		
Tungsten metal powder— 98/99%	1/11 lb.		
Ferro-chrome— 4/6% car.	£22	5	
6/8% car.	£21	5	
8/10% car.	£20	10	
Ferro-chrome— Max. 2% car.	£54	0	
Max. 1% car.	£15	0	
Max. 0.70% car.	£72	10	
67/70%, carbonless	1/6½ lb.		
Nickel—99% cubes or pellets	£137	10	
Cobalt metal—98/99%	11/- lb.		
Aluminium—98/99%	£100		
Metallic Chromium— 96/98%	4/9 lb.		
Ferro-manganese(net)— 76/80%, loose	£15		
76/80%, packed	£16		
76/80%, export	£14	10	
Metallic manganese— 94/96%, carbonless	2/3 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten	2	6
Finished bars, 18% tungsten	3	0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares 3 in. to 8 in. inclusive	4d. lb.
Rounds and squares under ½ in. to ¼ in	3d. lb.
Flats under 1 in. by ⅛ in. to ½ in. by ¼ in., and all sizes over four times in width over thickness	3d. lb.
Bevels of approved sizes and sections	6d. lb.
If in coils	3d. lb.
Packing	£3 ton.
Bars cut to length	10% extra

Scrap from high-speed tool steel—

Scrap pieces	3d.
Turnings and swarf	1d

Per lb. net, d/d steel makers' works.

SCRAP

	£	s.	d.	£	s.	d.
South Wales—						
Heavy Steel	3	10	0	3	15	0
Bundled steel & shearings	2	19	0	3	12	6
Mixed iron & steel	2	19	0	3	5	0
Heavy cast iron	3	10	0	3	15	0
Good machinery for foundries			4	0	0	
Cleveland—						
Heavy steel	3	8	0			
Steel turnings	2	14	0			
Cast-iron borings	2	12	6			
Heavy forge	3	12	6			
Bushelled scrap	2	16	3			
Cast-iron scrap	3	15	0			
Lancashire—						
Cast iron scrap	3	17	6			
Heavy wrought	3	7	6			
Steel turnings	2	2	6			
London—						
Copper (clean)	36	0	0			
Brass (clean)	32	0	0			
Lead (less usual draft)	22	0	0			
Tea lead	20	0	0			
Zinc	22	10	0			
New aluminium cuttings	60	0	0			
Braziery copper	48	0	0			
Gun metal	42	0	0			
Hollow pewter	130	0	0			
Shaped black pewter	90	0	0			

Above are merchant's buying prices delivered yard.

PIG-IRON.

N. E. Coast—	
Foundry No. 1	97/6
Foundry No. 3	92/6
Forge No. 4	85/-
Mottled	80/-
Hematite No. 1	93/9
Hematite M/Nos.	93/-
Midlands—	
Staffs. common	—
,, part-mine forge	—
,, ,, foundry	—
,, Cold blast	240/-
,, basic	—
Northants forge	70/- to 72/6
,, foundry No. 3	77/6 ,, 80/-
,, basic	80/-
Derbyshire forge	75/-
,, foundry No. 3	82/6
,, basic	80/-
Scotland—	
Foundry No. 1	105/-
,, No. 3	100/-
Hematite M/Nos.	107/6
Sheffield (d/d district)—	
Derby forge	82/6
,, foundry No. 3	86/6
,, basic	—
Lincs. forge	86/6
,, foundry No. 3	87/6
,, basic	86/6
E.C. hematite	102/6
W.C. hematite	102/6 to 105/-

All d/d in the district.

Lancashire (d/d eq. Man.) —	
Derby forge	—
,, foundry No. 3	90/-
Northants foundry No. 3	—
Cleveland foundry No. 3	—
Staffs. foundry No. 3	—
Lincs. forge	—
,, foundry No. 3	—
Summerlee foundry	116/6
Glengarnock foundry	118/6
Gartsherrie foundry	118/6
Monkland foundry	116/6

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.
Bars (cr.)	£10 10 to 11	10	0
Angles	£10 15 to 11	15	0
Tees to 3 united ins.	£11 to £12		
Nut and bolt	9	15	0
Hoops	14	0	0
Marked bars (Staffs.)	13	10	0
Gas strip	£10 10 to 10	15	0
Bolts and nuts, ¾ in. × 4 in.	17	10	0
Steel—			
Ship plates	£9 to 9	10	0
Boiler plates	12	10	0
Chequer plates	10	5	0
Angles	£8 12 6 to 9	0	0
Tee	£9 12 6 to 10	0	0
Channels	8	10	0
Joists	9	0	0
Rounds & squares 3-in. to 5½in.	9	15	0
Rounds, under 3in. to ⅜in.	8	15	0
Flats, over 5in. wide and up	9	15	0
Flats 5in. to 1½in.	8	5	0
Rails, heavy	8	15	0
Fishplates	14	10	0
Hoops	11	10	0
Blacksheets, 24 g.	12	0	0
Galv. cor. sheets, 24 g.	16	15	0
Galv. fencing wire, 8 g. plain	16	0	0
Rivets, ¾ in. dia	12	15	0
Billets, soft	6 0 0 to 7	0	0
Billets, hard	7 0 0 to 8	0	0
Sheet bars	6 17 6 to 7	7	6

PHOSPHOR BRONZE.

	Per lb basis
Strip	1 3
Sheet	1 3½
Wire	1 3½
Rods	1 2½
Tubes	1 6
Castings	1 1

Delivery 3 cwt. free to any town.

10% phosphor copper, £40 above price of B.S.

15% phosphor copper, £50 above price of B.S.

Phosphor tin (5%), £30 above price of English ingots.

Charles Clifford & Son Limited, Birmingham.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	11d. to 1/5
Rolled—	
To 9 in. wide	1/5 to 1/11
To 12 in. wide	1/5½ to 1/11½
To 15 in. wide	1/6 to 2/0
To 18 in. wide	1/6½ to 2/0½
To 21 in. wide	1/7½ to 2/1½
To 25 in. wide	1/8½ to 2/2½
Ingots for spoons and forks	11d. to 1/5
Ingots rolled to spoon size	1/2 to 1/8
Wire round—	
3/0 to 10. G.	1/8½ to 2/3½

with extras according to gauge

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	32.14
No. 2 foundry Valley	31.00
No. 2 foundry, Birm.	27.00
Basic	31.96
Bessemer	34.77
Malleable	33.96
Grey forge	32.27
Ferro-manganese 80 % delivered	—
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y, at mill	43.00
Bess. billets	40.00
O.-h. billets	40.00
O.-h. sheet bars	40.00
Wire rods	45.00
	Cents.
Iron bars, Phila.	2.32
Steel bars	2.00
Tank plates	2.00
Beams, etc.	2.00
Skelp, grooved steel	2.00
Skelp, sheared steel	2.00
Steel hoops	2.90
Sheets, black, No. 28	3.50
Sheets, galv., No. 28	4.50
Sheets, blue an'l'd, 9&10	2.60
Wire nails	2.70
Plain wire	2.45
Barbed wire, galv.	3.35
Tinplate, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	35/- to 37/6
,, furnace	26/- to 27/6
Durham & North. foundry	30/-
,, furnace	27/-
Other Districts, foundry	30/-
,, furnace	26 -

SWEDISH IRON.

Bars, hammered basis sizes Basis price £22 to £23

Rolled Ordinary— Assortment ..	£ 17	s. d. 10 0
Nail Rods— Square, round and flats ..	to 18	0 0
Keg Steel nom.	£38 to £40	
Faggot Steel nom.	£30 to £32	
Blooms— Single welded ..	£10 to £11	
Billets— Single and double welded	£13 to £14	

Pig-Iron—
Grey, white or mottled .. £7 to £7 10 0

Prices are without engagement. All quotations are f.o.b. Gothenburg, net cash against documents here.

TUBES.

	Up to and incl. 6 in.	
Gas ..	55%	Tube prices are now free.
Water ..	50%	
Steam ..	45%	

TINPLATES.

I.C.Cokes,	20×14, box	19/6
,,	28×20, ,,	39/–
,,	20×10, ,,	28/3
,,	18¾×14, ,,	20/1½
I.X.	,,	46/–
I.X.X.	,,	52/–
F.C.B.Y.	21×13⅝ ,,	36/6
C.V.B.G.	16¼×15, ,,	34/9
I.C.W.	20×14, ,,	17/6
,,	28×20, ,,	35/–
,,	20×10, ,,	24/6
,,	18¾×14, ,,	18/–
Ternepiates,	28×20, ,,	36/–

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Nov.	1	62	17	6	dec.	2/6
,,	2	62	15	0	,,	2/6
,,	3	62	12	6	,,	2/6
,,	6	63	5	0	inc.	12/6
,,	7	63	10	0	inc.	5/–

Electrolytic Copper.

Nov.	1	70	5	0	No change	
,,	2	70	5	0	,,	
,,	3	70	0	0	dec.	5/–
,,	6	70	0	0	No change	
,,	7	70	10	0	inc.	10/–

Standard Tin (cash).

Nov.	1	180	5	0	dec.	75/–
,,	2	179	2	6	,,	22/6
,,	3	183	15	0	inc.	92/6
,,	6	187	7	6	,,	72/6
,,	7	184	15	0	dec.	52/6

Tin (English ingots)

Nov.	1	180	0	0	dec.	80/–
,,	2	179	0	0	dec.	20/–
,,	3	183	15	0	inc.	95/–
,,	6	187	10	0	,,	75/–
,,	7	184	15	0	dec.	55/–

Zinc Sheets (English).

Nov.	1	40	0	0	No change
,,	2	40	0	0	,,
,,	3	40	0	0	,,
,,	6	40	0	0	,,
,,	7	40	0	0	,,

Spelter (ordinary).

Nov.	1	37	5	0	dec.	5/–
,,	2	37	5	0	No change	
,,	3	37	10	0	inc.	5/–
,,	6	37	15	0	inc.	5/–
,,	7	37	17	6	inc.	2/6

Lead (English).

Nov.	1	27	10	0	dec.	10/–
,,	2	27	5	0	dec.	5/–
,,	3	27	5	0	No change	
,,	6	27	5	0	,,	
,,	7	27	10	0	inc.	5/–

THE
ARMITAGE WORKS Co., Ltd.
Manufacturers of
Highly Refractory Bricks and Blocks
FOR ALL PURPOSES.

SPECIALITIES:
CUPOLA LININGS.
Ladle Bricks for Siemens Ladles.
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